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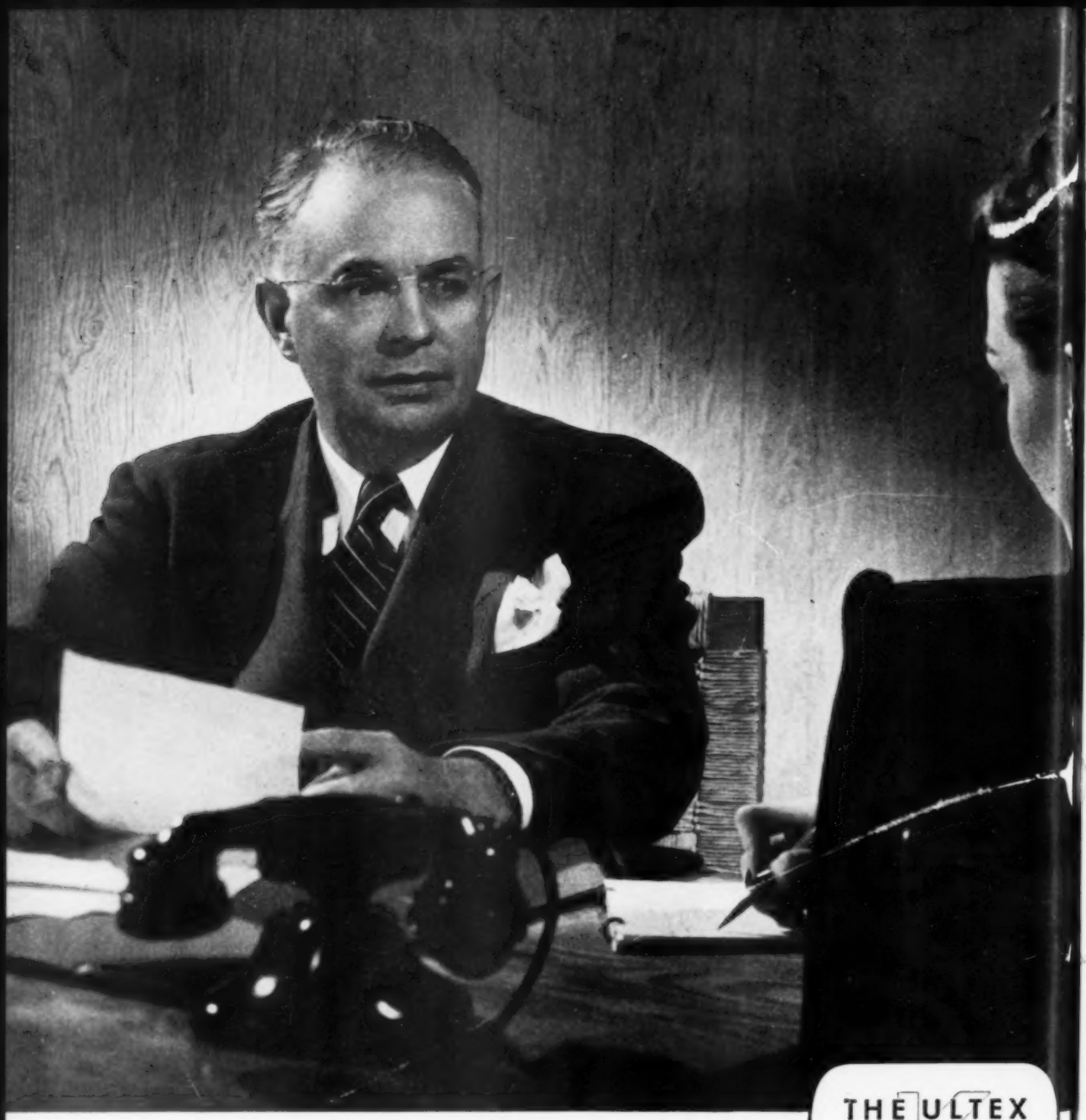

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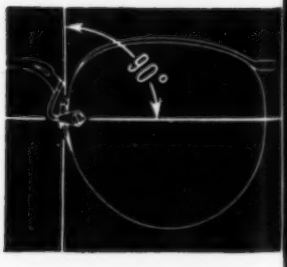

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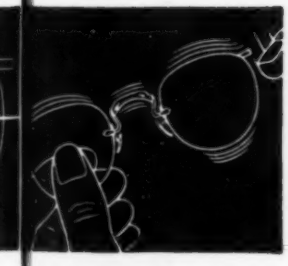

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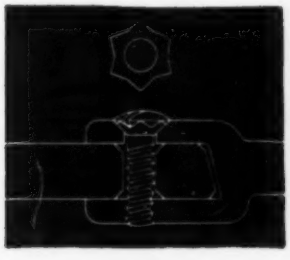

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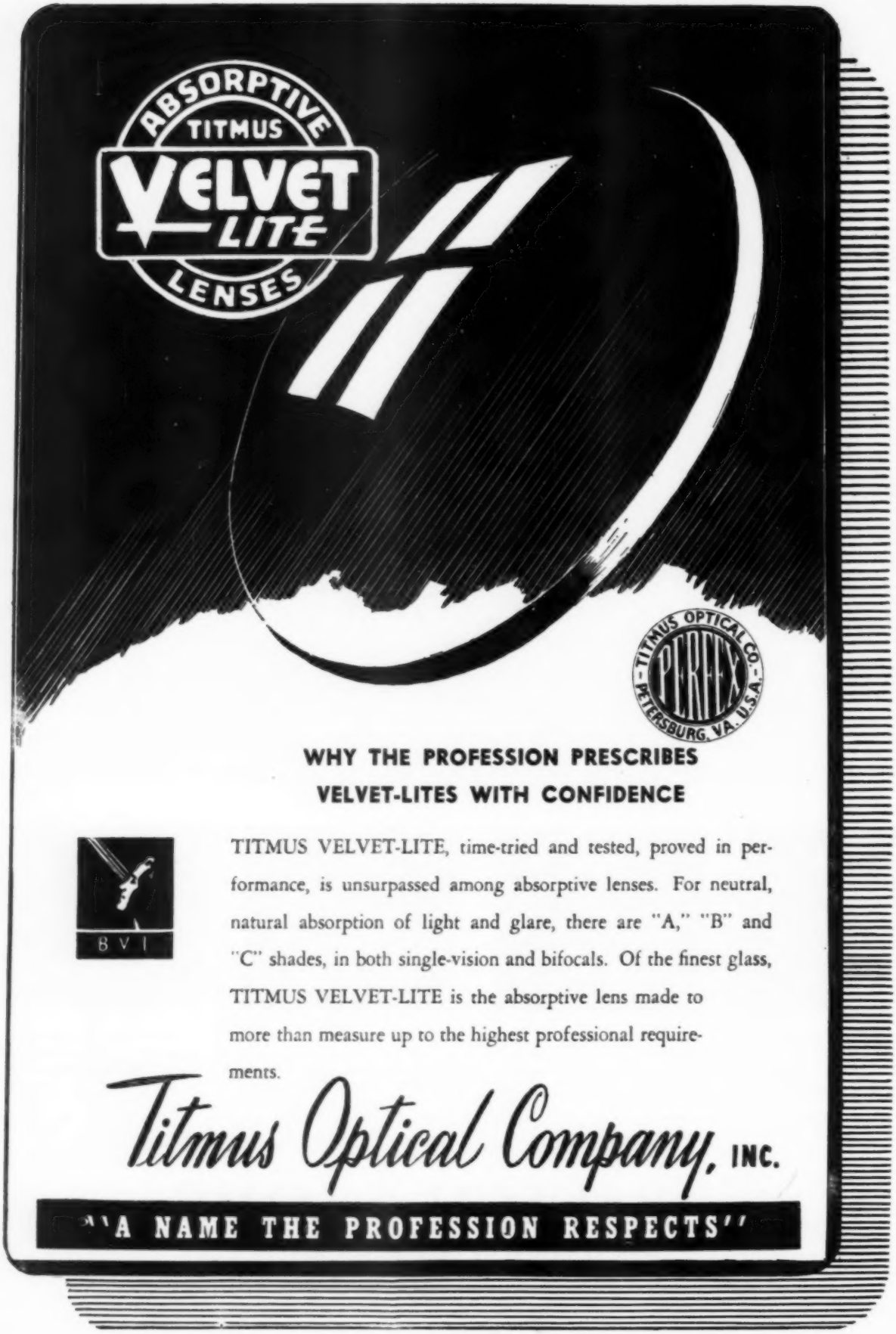

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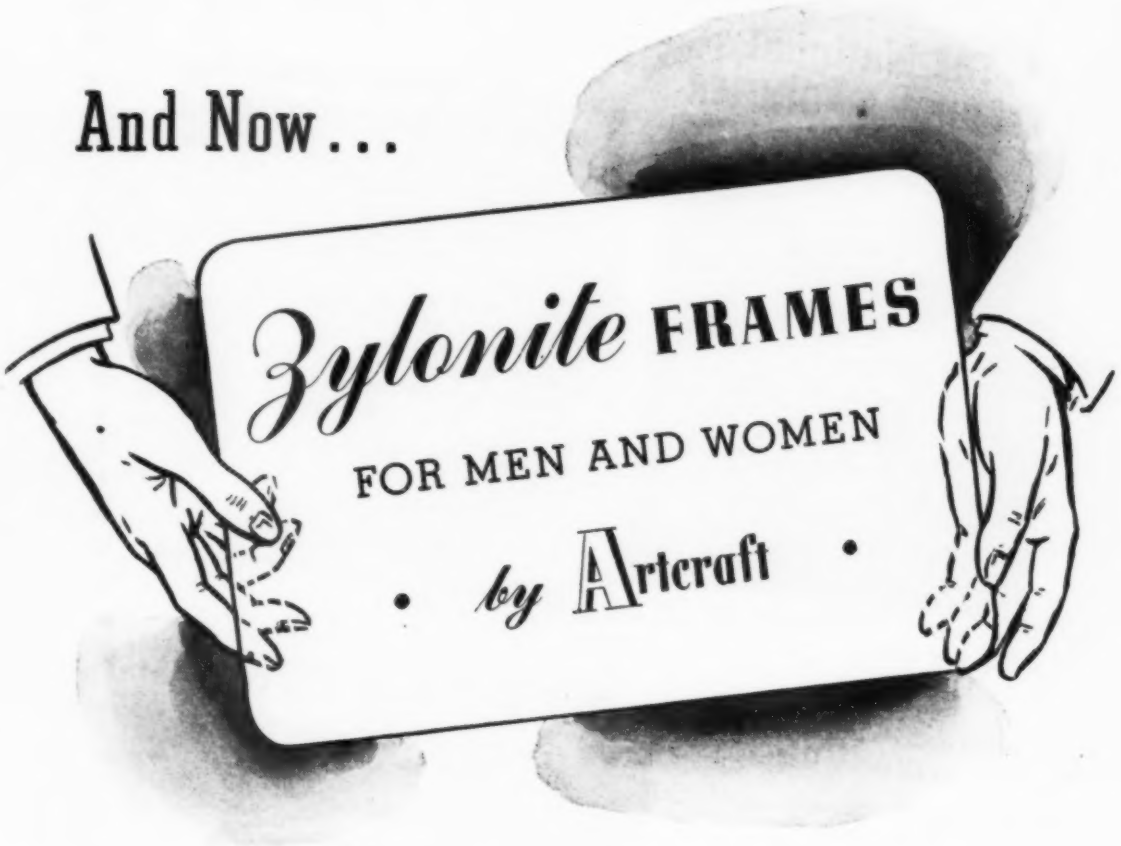

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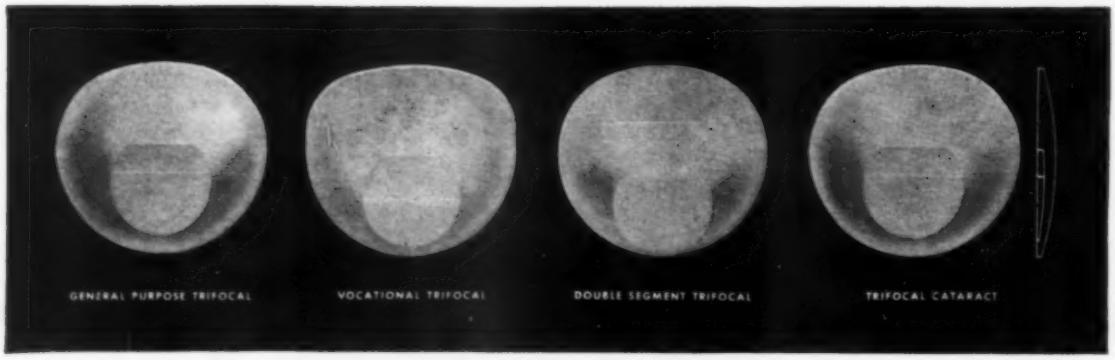

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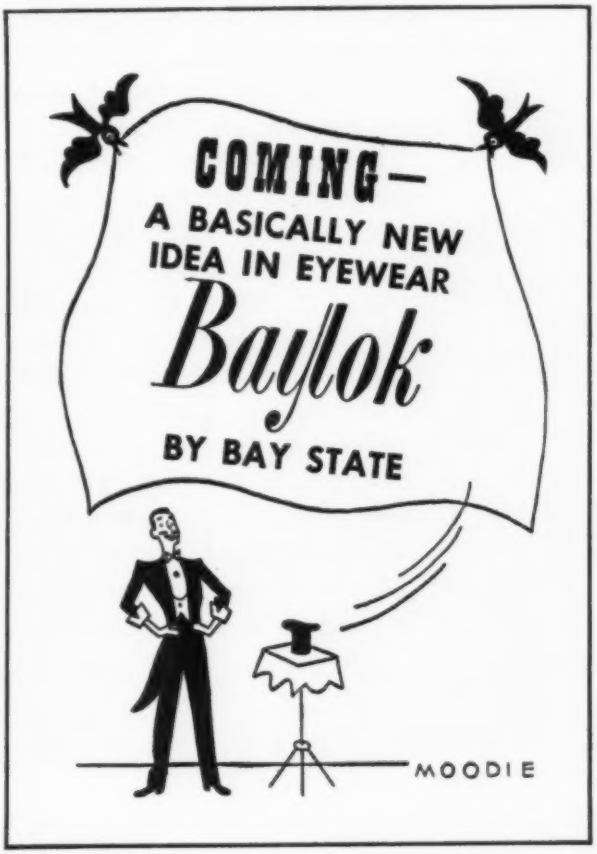
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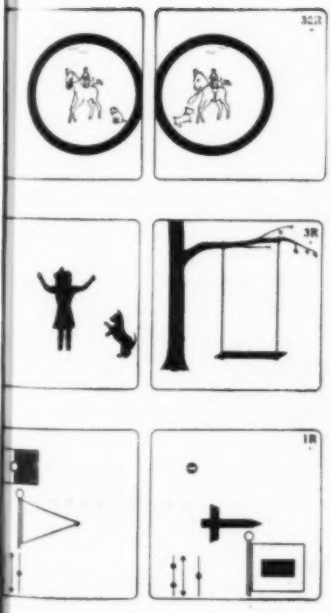

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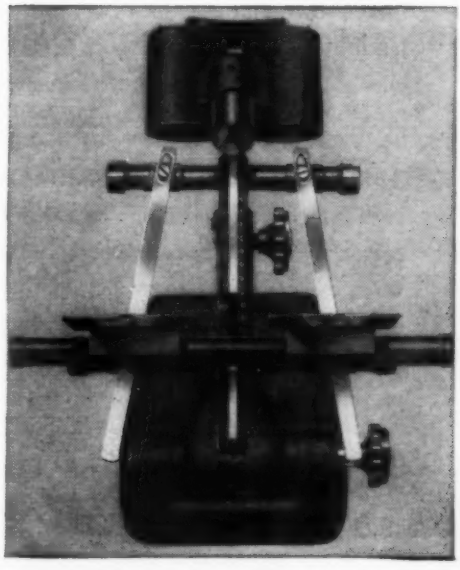

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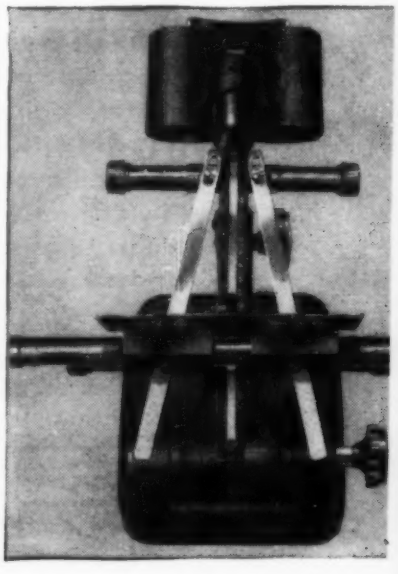

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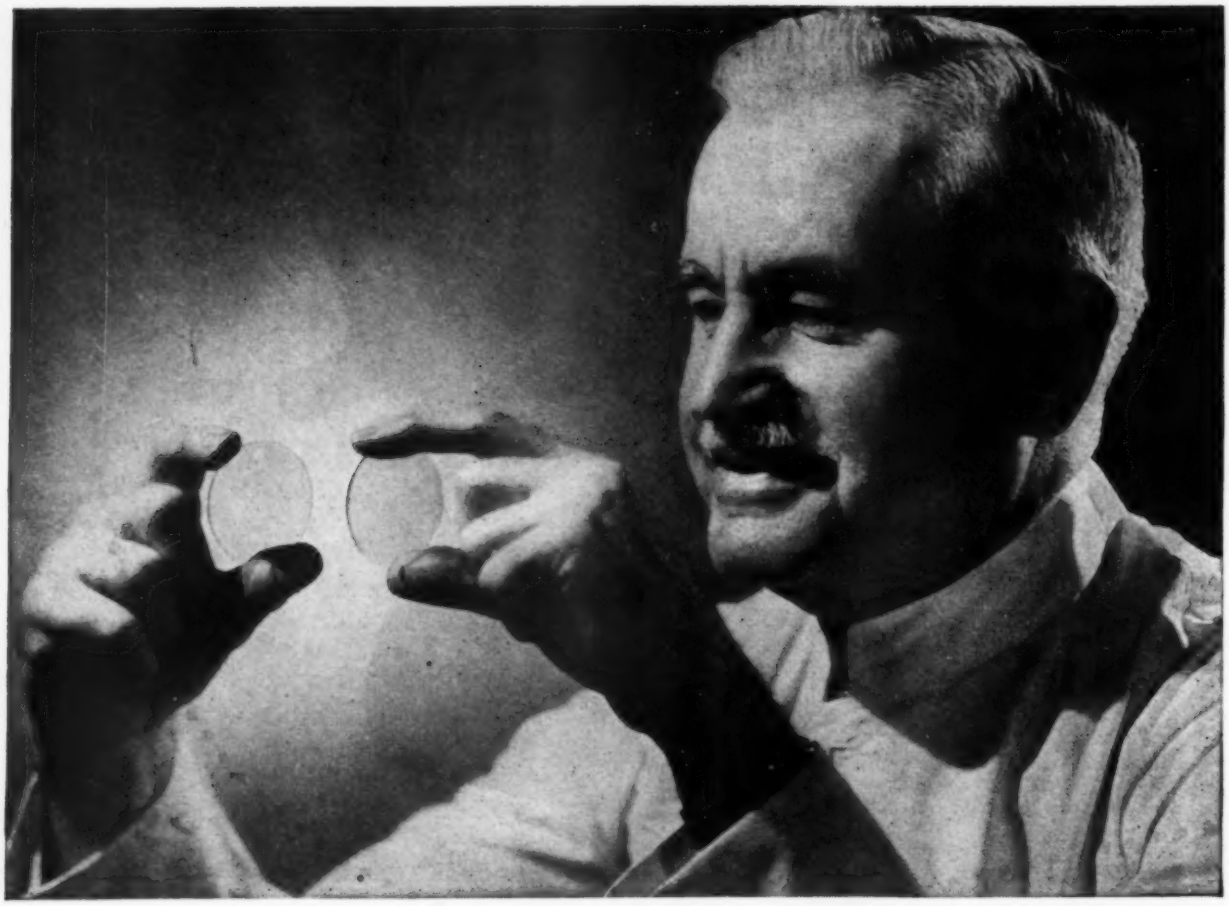

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Vol. 24 OCTOBER, 1947 No. 10

CERTAIN VARIATIONS IN THE ANGLE OF DEVIATION IN CONCOMITANT SQUINT*

Henry Wm. Hofstetter†
School of Optometry, Ohio State University
Columbus, Ohio

ABSTRACT

Haploscopic measurements of the angle of squint at different times in an exotrope showed periodic alternations between a large and small deviation with no other changes apparent in the accommodation-convergence relationship. Measurements on an esotrope prior to, during, and subsequent to wearing a prism correction showed compensatory changes in the angle of squint. These changes cannot be accounted for in the present classification of the convergence components.

It is not uncommon for a squinter to report that the deviation of his eyes varies from time to time. Such reports are usually based upon the squinter's own attempts to observe the degree of deviation in a mirror, or upon comments of his acquaintances. In general the reported variations do not seem to be associated with any other visual phenomena such as blurring, diplopia, or other asthenopic symptoms. In fact, the squinter typically is unable to relate the increase or decrease in deviation to any specific set of circumstances or physical or systemic conditions.

The writer has observed several exotropes of the intermittent and occasional type who, at given times, would be able to obtain normal binocular vision accompanied by a normal near point of convergence, proper bifoveal fixation, and in all respects quite satisfactory single vision without symptoms of effort or strain, and, at other times, would let one of the eyes diverge several degrees without a diplopia and without a blurring or change in acuity. In general, the subjects who exhibited this phenomenon did so involuntarily and were unable to tell whether

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*Read before the annual meeting of the American Academy of Optometry, Philadelphia, Pennsylvania, May 19, 1947. For publication in the October, 1947, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Fellow, American Academy of Optometry.

or not they were squinting except by self-observation in a mirror or by relying upon the report of the examiner.

One of the exotropic subjects investigated by the writer was able to make the change voluntarily. He could not describe how he accomplished this nor could he describe any difference in vision in the two conditions, although he could identify either by the "feel."

In most of the exotropic individuals exhibiting the above described alternations between squint and normal binocular vision an interesting observation was made with the routine cover test for squint. When the view of one eye was suddenly obstructed during normal binocular fixation the so occluded eye would remain unmoved or "straight" for a period of time lasting several seconds or even a large part of a minute after which it would be seen to "drift" rather quickly to its squinting position.

Similarly it was observed in several instances that a routine subjective phoria measurement would at first give approximately orthophoric readings which could be repeated several times in immediately successive trials, until subsequently the phoria readings would quite suddenly change to high exophoria values. The continuous observation of the patient's eyes behind the phorometer invariably showed a divergent movement of one eye simultaneous with the change in phoria findings. Occasionally, and inconsistently, there occurred a suppression of the image for the deviating eye so that instead of an exophoria reading, no reading at all was possible. In several instances the prism tests continued to show approximately orthophoric values even after one eye was observed to diverge. Subsequent tests for anomalous correspondence in the latter patients confirmed the fact that anomalous retinal correspondence was employed when the eyes were diverged in spite of the fact that normal retinal correspondence must have been employed during bifoveal fixation as evidenced by observation of the corneal reflexes.

One of the exotropes who showed normal retinal correspondence during the period of squint as well as during normal binocular vision was investigated by a special technique employing the mirror haploscope arrangement described in a previous article.[1] In brief, this apparatus provided images of identical Snellen charts to the two eyes so as to permit fusion when the relative positions of the two images seen in the haploscope corresponded to the angle of deviation of the subject's lines of sight.

The stimulus to convergence provided by the haploscope could

be varied by means of a constant speed motor drive and a gearshift arrangement. The driving mechanism was coupled with a recording device to permit continuous recording of the amount of convergence stimulus in effect.

Figure 1 is a continuous haploscope recording showing the repeatedly obtained limits of positive relative convergence during a 12-minute period. Points A and B illustrate two extreme convergence values far in excess of all of the others.

Changes in accommodation were prevented during the test by the continuous reading of letters representing the subject's maximum acuity. A small dot above one set of letters and a small dot below the other enabled the subject to identify fusion by the vertical alignment of the two dots. Careful observation of the movements of the eyes during the test was found sufficiently reliable to insure proper fixations, and therefore the use of normal retinal correspondence. That is to say that the converging movements of the subject's eyes were sufficiently apparent to permit the operator to judge when the eyes failed to follow the continuous increase in convergence stimulus and reverted to the phoria or tropia position.

Records of the same type were made on the same patient on six

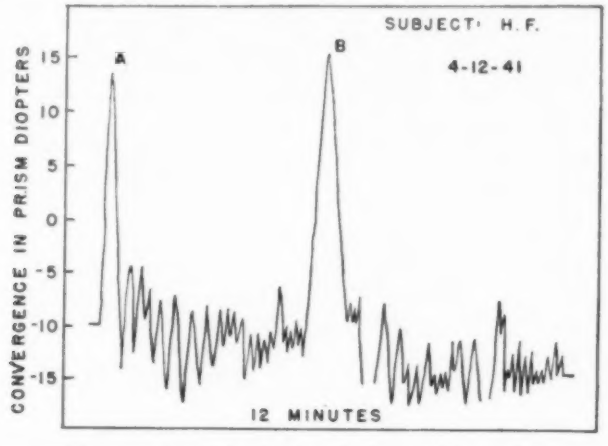

Figure 1. Ergographic record of the limit of the positive relative convergence. The upper limits of the tracing represent the amount of convergence stimulus at which a doubling or blurring of the targets occurred. The lower limits of the tracing are the points of recovery to fusion or clear vision. Parallelism of the lines of sight is represented by zero on the convergence scale. The stimulus to accommodation was maintained constantly at zero.

separate visits. As in Figure 1, each of the records showed the limits of positive relative convergence grouped around two widely separated

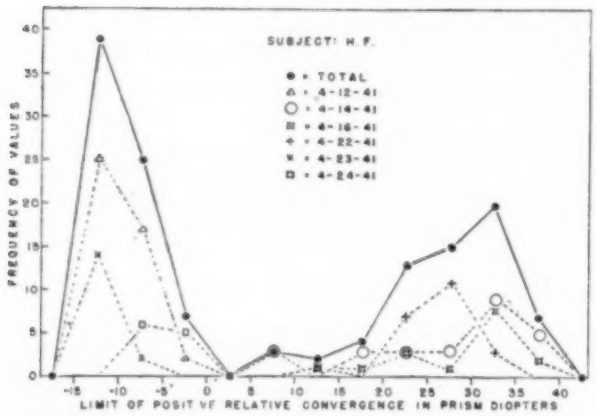

Figure 2. The distribution of findings of the limit of positive relative convergence in an intermittent exotrope. The curve is obtained from the data of 6 records of the type shown in Figure 1. The data from Figure 1 are represented by the triangular symbols.

values, the higher values corresponding roughly to the values A and B in Figure 1, and the lower values corresponding to the lower values in the same figure. The distribution of the values obtained in all six records as illustrated in Figure 2. The peak at the left of Figure 2 corresponded closely to the angle of squint. The peak at the right corresponded reasonably well to a normal limit of positive relative convergence such as one would expect in a case of normal binocular vision.

For the same individual a number of attempts were made to map

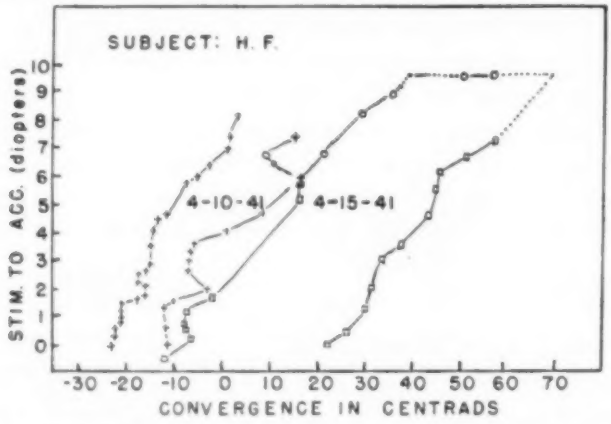

Figure 3. Haploscopic analysis of the zone of clear single binocular vision as obtained on an intermittent exotrope on two separate days. The crosses (+) show the positive and negative limits of relative convergence for the first day while the squares (□) show the range for the second day. The circles (O) are used in place of the squares or crosses whenever a blur was observed instead of a doubling.

out the zone of clear single binocular vision in a manner previously described.[1] Most of the records obtained presented a mass of confusing data because of the frequent alternations from squint to non-squint during the measuring procedure. Two of the records, however, showed a complete separation of the respective zones of clear single binocular vision, one of them being made during a visit when the patient was unable to obtain normal binocular vision and the other being made during a visit when he had no difficulty maintaining normal fusion. The two records are illustrated in Figure 3. Although the zone was not completely mapped out for the earlier of the two records illustrated, it may be assumed to reach the same height as the later one, namely 10 diopters, because the amplitude of accommodation repeatedly measured by a more routine technique was the same during and in the absence of squint.

The patient reported that the sensations of fusion experienced during the testing carried out on the later of the two visits were much more satisfactory in the sense that there was a more genuine feeling of fusion or blending whereas the sensations obtained in the earlier visit were appreciated more as a superimposition of the images with one slowly sliding past the other from out-of-alignment in one direction to out-of-alignment in the other, i.e., from crossed to uncrossed and vice versa.

A significant variation in the angle of squint has been observed under somewhat different circumstances in two esotropes. In both instances attempts were made to correct for the angle of squint by means of prism lenses for constant wear. Both patients had normal retinal

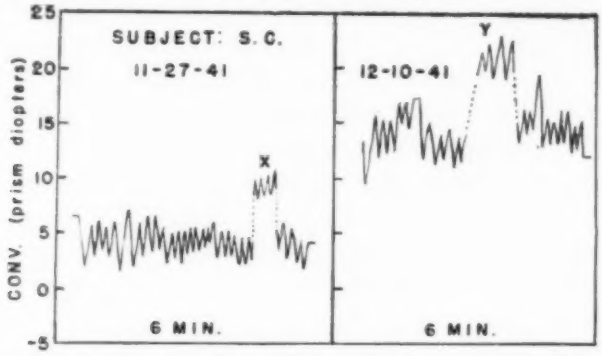

Figure 4. Ergographic records of the limits of relative convergence in an esotrope. The upper limits of the X and Y tracings indicate the limit of positive relative convergence; the lower limits represent the recovery to fusion. The lower limits of the rest of the tracing indicate the limit of negative relative convergence: the upper limits represent the recovery to fusion. The stimulus to accommodation was maintained constantly at zero in both tests.

correspondence and very small angles of squint and were being given occasional tests on the mirror haploscope to determine the range of clear single binocular vision. The recording arrangement described in connection with Figure 1 was used to determine the limits of both the positive and negative relative convergence.

The tracing of the left half of Figure 4 is a typical record of one of the two esotropes prior to his wearing a prism prescription. The lowest limits in this tracing represent the negative relative convergence limits, the break points averaging about three prism diopters of esotropia and the recovery points averaging about 5.5 prism diopters. The portion labeled with an X represents the positive relative convergence limits, the break points averaging about 10 prism diopters of convergence and the recovery points averaging about 8.5 prism diopters.

The tracing in the right half of Figure 4 is a record of the same esotrope two days after he was fitted with a correction containing 4 prism diopters of base-out prism in each lens. The lowest limits in this tracing represent the negative relative convergence limits, the break points averaging about 12 prism diopters of esotropia and the recovery points averaging about 14 prism diopters. The portion labeled Y represents the positive relative convergence limits, the break points averaging about 22 prism diopters and the recovery points about 19 prism diopters. Both the before and after records were made through the original prescription which contained no prism.

It can be seen from these records that a new position of the eyes was assumed soon after the prism correction was fitted. This new position or angle of squint enabled the patient to maintain approximately the same relationship with respect to the position of the images on the retina as was maintained before the prisms were prescribed. In other words he was an 8 prism diopter esotrope before the prism Rx., and a 16 prism diopter esotrope after the prism Rx.

By means of fitover lenses an additional amount of prism was worn for a day; the squint increased accordingly. The original prescription containing no prism was then put on again for constant wear. Tests made on subsequent visits showed the return of the angle of squint to its original value.

These changes did not seem to occur during the usual half hour or hour of one visit; rather they seemed to require several hours of wearing of the prism. No loss of acuity was experienced by the subject while wearing the prism. No change in the manifest refractive error was detected to correspond to the change in squint angle.

THEORETICAL CONSIDERATIONS

The following components of convergence have been previously defined and described.

1. TONIC CONVERGENCE.[2] In general, the tonic component has been described in terms of the innervation which shifts the relative position of the eyes from an anatomical position of rest (as assumed immediately after death) to the functional position of rest as assumed in the absence of stimuli to the other three components herein listed. This component is attributed to the summation of extra-ocular innervation resulting from the general tonus of the central nervous system and the special reflexes originating in the vestibular and other ganglia. As such this component must be considered to be quite invariable in any ordinary range of circumstances.

2. ACCOMMODATIVE CONVERGENCE.[2, 3] This has been defined as that convergence occurring in direct response to or as a function associated with accommodation. The convergence data described in this paper were obtained with the accommodation stimulus constantly at zero.

3. FUSIONAL CONVERGENCE.[1, 2] This may be defined as the convergence which can be brought into play without changes in accommodation and in direct response to disparate stimuli or diplopia. This type of convergence may be divided into positive and negative fusional convergence depending upon whether the fusional movement elicited is a response to nasally or temporally disparate images, i.e., whether the movement elicited is one of convergence or divergence.

4. PROXIMAL CONVERGENCE.[4] This may be defined as the convergence brought into play by the awareness of the nearness of the fixation object, i.e., the presumed or perceived distance of the object irrespective of the actual optical stimulus provided. It has not been shown conclusively that this is physiologically separable from the fusional convergence although a preliminary unpublished investigation by the author suggests that this is the case.

In view of the observations reported in this paper it must be assumed that all of the convergence manifestations of the eyes cannot be accounted for on the basis of the above-listed components as defined. Each of these can be eliminated as follows:

1. The tonic convergence cannot be assumed to vary sufficiently to account for the changes described unless it is assumed that the basic tonicity provided by the central nervous system and the peripheral ganglia is subject to momentary changes without other obvious manifes-

tations. It also must be assumed that the tonic convergence is ruled out in the one case of the exotrope who showed voluntary control over the variation in angle of squint.

2. The accommodative convergence is ruled out as a factor because of the relative constancy of the accommodation indicated by the absence of blurring which would be expected if the accommodation changed. The subjects' continuous reports of ability to read letters corresponding to their maximum acuities were taken as evidence that the actual accommodation was at least approximately equal to the stimulus value at all times. Also the lack of change in the refractive error as represented by the lower limits of the graphs in Figure 3, and the constancy of the amplitude of accommodation may be taken as evidence that accommodation was not related to the change in angle of squint. It is of incidental interest that the A.C.A. ratio did not vary significantly in the change from squint to normal binocular vision in the case represented in Figure 3.

3. That fusional convergence is not a factor is shown in all of the records obtained, wherein it is seen that the positive and negative limits of the range of fusion shift with the change in angle of squint.

4. Proximal convergence is ruled out by the fact that the changes in angle of squint occurred without the changes in instrumentation and procedure necessary to evoke variations in judgments of the perceived distance of the test objects. All of the tests were made with the same apparatus.

It becomes necessary, therefore, to define an additional convergence component to describe the total act of convergence of the eyes. The observations herein described hardly permit a definition of the conditions that are necessary to produce or isolate this type of convergence. They only illustrate the inadequacy of the present classifications and their respective definitions to account for all of the factors involved.

It is possible, on the one hand, that the observations made on the esotropes and exotropes represent separate physiological mechanisms. On the other hand, it may be true that they represent one and the same mechanism and furthermore that they may be related to certain preliminary observations that have been made in subjects having normal binocular vision, such as the variations of the phoria in prolonged occlusion described by Marlow,[5] the vertical imbalance effects induced by anisometropic corrections described by Ellerbrock and Fry,[6] the temporary variations of the phoria in prolonged accommodation effort previously mentioned by the author,[7] and the temporary variations in phorias and

ductions that are often observed to occur during base-out orthoptic training. Likewise the squinters' own reports of periodic changes in the degree of squint may be based upon manifestations of the same mechanism.

CONCLUSION

Preliminary observations made on several concomitant esotropes and exotropes indicate the presence of a component of convergence that cannot be classified within the definitions of any of the four commonly recognized components, namely, tonic, accommodative, fusional, and proximal convergence.

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THE STEREOSCOPE AS A METHOD OF MEASURING DISTANCE DISCRIMINATION*

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Prior to Howard's work[1] of 1919, the stereoscope was widely used as a method of testing distance discrimination. In the years between the first and second world war the Howard apparatus, with a few modifications, became the standard method and was used by all branches of the military services. At present, the stereoscope is widely used in industry and school screening and, during the recent war, a few military bases used this method in addition to, or instead of, the Howard apparatus. It is interesting that the Manual of Ocular Tests[2] lists the Howard-Dolman as the test used by the United States Army, Navy and Civil Aeronautics Authority, while the stereoscope and the depthescope are described as the "clinical" methods. Since one apparatus is used for the vast majority of military testing and the other for clinical work, it would be well to know whether the results of the two are comparable.

Warren[3] in 1940 tested distance discrimination, using the average deviation based upon 10 trials on the Howard-Dolman apparatus as the threshold and also using the Keystone stereopsis test which consisted of a graded series of 24 cards. For 61 subjects Warren found the reliability coefficient by correlating odd and even trials. For the Howard-Dolman this was +0.93 and for the stereoscope it was +0.86. Even after the correction for attenuation had been applied, the correlation between the two tests was only +0.119, which does not differ significantly from zero. Warren concluded that this lack of agreement between the tests raises serious questions of the validity of one or both of the tests. He pointed out certain weaknesses of the two tests which might be responsible for the low intercorrelation—the size cue as a confusion factor in the stereoscopic test and the introduction of eye-hand coordination in the Howard test.

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Langlands[4] also compared the stereoscopic method with the method of direct comparison of two objects in space. Since he used Howard's original design which was a constant method, the eye-hand coordination factor was absent. Also, since he used a Pulfrich stereoscope, one superior in many respects to the Keystone, the size cue was not presented in an incongruous fashion. For 10 subjects whose distance discrimination was carefully measured over a period of two and a half hours, Langlands found no significant correlation. By the method of rank correlation, the coefficient computed from Langlands' data was found to be +0.206, while the Pearsonian *r* was +0.018, neither value differing significantly from zero. The conclusion drawn by this author was that ". . . sometimes inexperienced observers, who have a good binocular acuity with the unaided eyes obtain poor results when tested with a sterescope."

The experiment of Warren has been repeated with a few changes of procedure in the Vision Laboratory, and essentially the same results were obtained. Sixty observers were tested on the Howard-Dolman apparatus and on the Keystone telebinocular with the DC series of cards. The test was repeated exactly one week later. Thus, the test-retest correlations, rather than being based upon five observations as in Warren's work, were based upon 10 for the Howard-Dolman, and test and retest were separated by one week. Instead of the average deviation from instrumental zero, the standard deviation of the 10 observations was calculated and used as threshold. The test-retest correlation for the stereoscope yielded a coefficient of +0.826, very close to that of Warren. The Howard-Dolman, however, even with the more stable standard deviation of 10 cases, yielded a reliability coefficient of +0.517, which was considerably lower than that found by Warren of +0.93. It should be pointed out, however, that Warren probably used an unrestricted range of visual acuities since he mentions the correlation between visual acuity and depth acuity. On the other hand, in the present series the range was restricted, all subjects having visual acuity of approximately 20/20 in each eye. Weymouth and Hirsch[5] have shown that restricting the range of thresholds on the Howard-Dolman and reducing the number of cases from 29 to 24 reduced the reliability coefficient from +0.86 to +0.18. This was interpreted by them as indicating that this test distinguished between gross differences in distance discrimination only.

In the experiment conducted at the Stanford Vision Laboratory, the test and retest data for the Howard-Dolman and for the stereoscope for the 60 observers were combined, giving 120 pairs of observations. The correlation coefficient between these two tests was +0.224, which

was significant to the one per cent level; correcting for attenuation raised this to +0.343. This low but significant correlation coefficient may be interpreted as meaning that 12 per cent of the variance of one method is due to the variance of the other. Clearly then, the work of Warren, Langlands, and the present author all demonstrate the fact that the stereoscope is of little or no value in predicting performance in distance discrimination or depth perception where the relative distances of two objects are to be compared.

This conclusion is rather surprising when we consider that in both the stereoscope and in the Howard-Dolman test, retinal disparity is the thing being measured. Why, then, the lack of agreement for the two methods? The work of Weymouth and Hirsch[5] throws some light on this. They found that the frequency distribution of stereoscopic scores was clearly bimodal, while all of the other tests for distance discrimination used at the Vision Laboratory yielded unimodal frequency distributions of thresholds. The bimodality of stereoscopic results seems to indicate that some factor other than retinal disparity is influencing these thresholds—and to such an extent that the individual differences in distance discrimination are obscured. This other factor we may call "ability to use the stereoscope." The stereoscopic tests, as administered at present, may be said to divide the population into two groups; those who possess this ability and those who do not. The high reliability for stereoscopic measurements can be interpreted as meaning that, unless training occurs, this ability is not very variable over a short period of time.

One case encountered in the present series is worthy of comment. This subject's score on the Howard-Dolman was 15 per cent from the lowest on the test and 7 per cent from the lowest on the retest. (Rank position of 51 and 56 for 60 observers). However, on the stereoscope his score was 100 per cent stereopsis on both test and retest. He mentioned that he had been receiving visual training from an optometrist who had used the telebinocular. Here, then, was a case whose "poor stereopsis" had been "cured," but who still was one of the lowest on the Howard-Dolman. It seems probable that the training had merely succeeded in making him one of those who possessed the ability to use the stereoscope, while not affecting the sensitivity of retinal disparity. Too much stress should not be placed upon a single case, but one of the fields of future research seems clearly indicated. It is becoming obvious to many that training on the stereoscope increases ability as measured by the stereoscope; training with Ishihara charts increases ability to pass color blindness tests on the Ishihara charts; training on visual acuity

charts improves ability to read these charts. It would be well to determine whether these ablities carry over to other tests. The case just cited is one in which training did not carry over. The validity of training procedures requires such transfer of learning.

The results obtained with the stereoscope seem to have no value in determining the performance of an individual in comparing the relative position of two objects in space. There is a second and equally important consideration. The work of the Vision Laboratory at Stanford over the past four years has demonstrated that the Howard-Dolman apparatus can be made to yield the position of subjective equality, a reliable measure of functionally corresponding points. This parameter is the mean of the observations expressed as a deviation from instrumental equality: minus if it falls in front, and plus if it falls behind. In a sense, this serves as an indication of the tilt of the horopter and, thus, if the Howard-Dolman test is properly administered and scored, the results may be used to determine the presence and to estimate the degree of aniseikonia in the horizontal meridian. Such information is, needless to say, valuable to the practitioner. However, while the Howard-Dolman test may be made to yield such information, the stereoscope, as used at present, cannot. While it might be possible to devise a set of cards with which the position of subjective equality could be determined, such sets are not now in use. Further, even if such a set of stereograms were available, the serious objection of ability to use a stereoscope discussed above still would be present.

Summary. (a) Langlands, Warren, and the present author independently found positive correlations, all small and only in one case significant, between the Howard type of apparatus and the stereoscope. The significant correlation, even after correcting for attenuation, had a value of +0.343, which may be interpreted as meaning that 12 per cent of the variance of one method is due to the variance of the other.

(b) Weymouth and Hirsch have in another paper shown that the distribution of thresholds obtained on the stereoscope is bimodal. This seems to suggest that a variable of perhaps greater weight than retinal disparity is one of "ability to use a stereoscope," and that the scores obtained are influenced greatly by this factor.

(c) While the Howard-Dolman test may be administered in such a manner as to yield valuable information concerning the presence and degree of aniseikonia, no stereoscopic method at present employed can be used for this purpose.

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DEVELOPMENTS IN THE CORRECTION OF SQUINT*

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Once in a great while men with extraordinary thinking powers come along and shed light on some of our most perplexing problems. We are grateful to Dr. Frederick Brock, optometrist of Staten Island, New York, for making his invaluable contributions toward a more scientific understanding of the causes, effects and treatment of squint. It should be clear at this time that a strabismic individual does not suffer from any muscle weakness if he is not *paretic*. We are dealing with psychological habit-forming situations which the individual has learned in order to pacify and satisfy the higher brain centers for clear, single and comfortable vision. In short, the eye has turned in order to avoid diplopia. It does so because the object of regard falls on the periphery of the retina of the turned eye where it can easily be suppressed. The longer the squinting period, the more permanent becomes the suppression. However, there are some squinters who constantly see double, either because of a paresis or a macular aversion to fusion. Diplopia occurs for a long period of time after operative procedure until fusion becomes complete. Singular binocular vision is existent in these cases at the near point but because of a tight convergence and divergence relationship at distance, a very small angle of squint exists.

Aside from the paretic and paralytic squinters, we have two main classifications of strabismus.

(1) Monocular
   a) Amblyopia ex anopsia—accommodative
   b) Central scotoma

(2) Alternators—anomalous projectors

Some monocular squinters are also anomalous projectors, but the majority by far are the alternators. Since the basic treatment is the same for all, there is no need of setting up separate classifications for esotropia, exotropia and vertical tropias. The use of base-in or base-out prism training is an obvious factor depending upon the direction of the squint. The treatment for normal projectors is identical for the anomalous pro-

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jectors except that in the latter case the development of binocular awareness is much more difficult.

For many years we have been laboring under the impression that anomalous retinal correspondence or false macula, for example, exists in squinters. Experiments conducted by Verhoeff and Brock[2] proved to us there is no such thing. Correspondence is innate, and anomalous projection is due to a learned muscle sense of projection. In other words, if we are dealing with an exotrope whose right eye turns outward, one would expect in anomalous projection to have the patient localize the image for the right eye on the right side of the image for the left eye. This is contrary to the expected in normal cases of diplopia. The projection is different, not because of a false macula but the accustomed angle of squint which dictates to the brain that the image for the right eye belongs on the right side.

It is highly important before undertaking any squint training, that an exhaustive study be made of the patient's history in order to determine the probable cause of the squint. It could be inherited, traumatic, or acquired after certain illnesses. Finally, a marked anisometropia may cause an eye to turn if glasses are not worn at the proper time. Many cases have been seen of exotropia or high exophoria bordering on tropias with histories of anemia and low blood pressure in people of the procrastinating type. Some of these exotropias are also common among hypertensive individuals. Anomalous projection exists in almost 100 per cent of alternators of long standing. A blow in the occipital region may create a central scotoma and thereupon induce a squint. Convulsions, whooping cough and diseases with high fevers may induce squints with or without central scotomas. One can readily determine whether a central scotoma or an amblyopia exists by the use of a simple instrument such as the Brock projection box providing anomalous projection is non-existent.[12, 17] If the squint is of an hereditary nature one can expect anomalous projection to be present and naturally the prognosis is unfavorable and the length of treatment prolonged. Squints due to errors of refraction are most amenable to training. The traumatic types, providing paresis is absent, will respond quite readily. Of course, if the squint is of long standing the chances for complete cure are diminished. Should any slight paresis be present the patient should be told that operative procedure may be necessary once binocular awareness and some depth perception have been established. It is best to tell the patient of his or her chances for complete cure in order to avoid any misgivings later on.

At this point a test should be made which will give some indication of the presence of a fusion center that is operating although principally lying dormant. The Brock ring test is classical for this procedure.[18] The patient wears a green free filter over one eye, preferably the squinting one, and a red free filter over the other eye. Through his correction, or with additional plus if esotropic and additional minus if exotropic, he observes these Brock rings placed at the crossing point of his visual axes. Unless a scotoma of large proportion exists in the squinting eye the observer will report a sense of spatial perception. The fused rings either will appear to emerge from the card or recede, depending upon the position of the rings and the filters. In cases of extremely poor vision in one eye it is best to project these rings on a screen as supplied with the Keystone flashmeter. Unless the patient reports some movement to and fro of the rings he is not amenable to training. However do not construe this to mean that any patient who gives the correct answer is sure to be cured. The writer is merely emphasizing the fact that no report at all is reason enough not to accept the case for training. Peripheral areas are easier to work with in developing fusion. Using the stereo-motivator in projecting the BU rings utilizes the peripheral areas of fusion. When these areas are dormant it is hopeless to expect more central areas to respond to treatment.

One can demonstrate normal projection by means of two colored strings.[5] Have both strings meet at some distant point and bring them back in a V formation, one to each eye. Fixate at the point where the strings meet and the resultant sensation will be one string of mixed colors. The same experiment conducted on an anomalous projector will produce a sensation of two strings localized according to the existing angle of squint, or just one string will be seen of one color, indicating total suppression. A similar experiment can be conducted with one string which is placed at the tip of one's nose. A red filter is placed over one eye and a green filter over the other eye. A normal projector will be conscious of two colored strings meeting in a V formation at the further end. One colored string will appear to go towards the right ear and the other towards the left ear. If the red filter is over the right eye correct projection will place the reddish string going towards the left ear while the green string will go towards the right ear. The anomalous projector will see the colored strings in reversed position.

Another method of testing for anomalous projection would be by means of the Bielschowsky after-image test. This test calls for observing the center of a vertical streak of light with one eye and the hori-

zontal streak with the other, each of twenty seconds' duration and the other eye occluded, as each eye is treated separately. In normal projection the resultant after image would be a cross whereas in anomalous projection the after image would be a vertical line on the side of the eye which observed it and the horizontal line on the opposite side. This test is not too reliable inasmuch as some cases will not report a proper after image. Some will say that just one of the lines is seen separately. Some will report a cross when the test is taken at 20 feet and anomalous projection when taken at 10 feet or vice versa.

An absolute test could be made with the BU 1, 2, 3 cards of the Keystone series. Here, even if the total prism equivalent to the angle of squint is placed in the lens cells, the patient will report two separate pictures of either one alone with the utter lack of luster, or first degree fusion.

It is important before training is begun to have a heart-to-heart talk with the patient, trying in every way to explain exactly how he sees and to demonstrate how a normal individual sees. The first step in training involves teaching the patient binocular awareness or simultaneous binocular perception. Take a square piece of transparent glass and hold it in front of the fixating eye which is looking at a distant source of light. The patient is made aware of two objects, thereby, both seen in the same line of direction. The patient is told that this is a sample of a composite picture as seen by a normal pair of eyes, the only difference being that one eye is receiving one object (the transparent glass) while the other is viewing the distant object and fusion of both takes place in the higher brain centers. The patient immediately agrees that viewing monocularly the distant object through the glass is a rather simple task.

Then proceed with normal replacement training,[10] which is nothing more than the development of binocular awareness of images, one for each eye, that are seen in the same line of direction. It is a more advanced type of luster. While the fixating eye views a distant point source of light, a flashlight with a red covering is placed a few millimeters in front of the center of the pupil of the non-fixating eye. The light is flashed off and on until the patient reports that the distant fixated object is seen through the flash. Then make the light continuous but move it a little further away making sure the light is centralized in his pupil. The further away the flashlight can be moved while the distant light appears in the center of the red light the better entrenched is normal replacement. This task is not as easy as it sounds. Anomalous projectors

find it quite difficult to keep the two stimuli in the same line of direction. In order to avoid any interference of the flashlight with the seeing of the fixating eye a mirror may be used before the fixating eye, so that both eyes may appear to be looking off in a parallel manner. Unfortunately, every patient will not respond to this sort of treatment, so other means of developing normal replacement were then looked for and found.[4] For instance, over the squinting eye is placed a cone, open at its base and with the apex, which has a tiny opening, pointing to a transilluminated area of light. The patient will report a speck of light within a gray circumference somewhere on the transilluminated area. This should be an easy manner of demonstration for normal replacement. Another method for eliciting this primary type of fusion would be to have the fixating eye observe a point on some light gray area while the non-fixating eye is closed and transilluminated through the upper lid. The light bulb should be localized around the pupil of the non-fixating eye. The resultant impression should be a yellowish or slightly reddish glow surrounding the fixation point. Another simple method may be employed by testing with BU 1, 2, 3, cards of the Brock Keystone series.

Obviously, a pair of squinting eyes will not straighten unless the patient has a good sense of diplopia and correct projection. The next step, therefore, would be to develop his sense of correct diplopia. This we do with the aid of the red-green filters and a source of light, preferably a strong one such as an electric light bulb. The first reaction of the patient unvariably will be that he sees but one colored bulb. If the red filter is over the right eye and the patient reports seeing a red bulb, then quickly cover and uncover the other eye a few times and the second colored image may appear somewhere off to the right or left of the image of the fixating eye depending upon the type of tropia, of course. In esotropia, if the left eye is turned in, the image for that eye should appear to the left of the image of the right eye. However, in cases where anomalous projection still persists, the patient will report a reversal of the imagery. One must be tolerant with the patient and urge him to seek the images in their proper positions. The placement of a vertical prism before one eye will help in introducing the second image more clearly. Then remove the vertical prism and see if the second image gradually appears in its rightful place. This type of treatment can be done with a red filter over the non-fixating eye leaving the other eye to observe a white light. Ask the patient to alternate fixation and still maintain the diplopia. Finally, no filters at all should be used and diplopia should be developed to the point where the patient will have a persistent

and annoying diplopia not only in the office but on the street and at home as well.

When anomalous projection has been fairly well eliminated and the sense of diplopia is persistent, we are ready to develop the fusion of both dissimilar and similar objects. Suppression, always a hindering factor in true fusion, must be eliminated. The BU 10, 11, 12 and other suppression cards in the BU series should be used with the aid of prism at this point. The patient is now ready to be moved up as near the fixation light on the wall as possible until he is able to fuse the two images. It is advisable to use the red and green filters so as to give the patient a sense of color mixture at the crossing point of his visual axes; also to prevent suppression during the exercise. In esotropia it is advisable to apply as much plus as possible during this training so as to reflexly relax convergence and thereby reduce the angle of squint, while in exotropia, strong minus lenses should be used to stimulate convergence.

The patient, having fused the two images, (preferably large electric bulbs at first), should move away from the fixation light and try to maintain single binocular vision. He should move back to the point where diplopia sets in and then move forward to the fusion position. In this manner, the patient moves towards and then away from the target until he can readily move to twenty feet away and still maintain single binocular vision. If the patient can accomplish this feat, use opposing prisms to add to his task and walk him back and forth again, increasing the distance and the amount of prism used.

In esotropia employ base-in and the reverse for exotropia. Slides, such as SR 7, 9, 10, 13 in the three dimensional set or those made by Keystone can be employed in similar manner using the red-green filters. The rotoscope can be used with jewel target and other fusion cards working in the opposite direction of the tropia. It is best to work with large targets at first in order to avoid horror fusionalis. This is a macular aversion to fusion. The Brock rings are excellent targets to work on because they can be used in many sizes, are easy to fuse, they maintain stereopsis and avoid suppression.

Another method for developing ductions can be utilized by means of the string experiment as described earlier. A small flashlight should be placed at the point where the two strings appear to meet. The training simply involves the procedure of moving the light further away on the string while the patient is still conscious of the two colored strings meeting at the light forming a V. The same exercise can be used with the end of the string being attached to a card of Brock rings fixed on

the wall. A white circular patch in the center of the rings is fixated upon and the depth perception created by the rings acts as an aid in maintaining a single white patch. Here the patient can move out to twenty feet holding the string to his nose, always conscious of one white patch, the space perception of the rings and the two strings converging to a point in the center of the white patch.

Various polaroid slides of the three dimensional series can be used along with the PF base-in and base-out Keystone series for developing fusion, ductions and stereopsis.

In cases where central scotomas exist only large fusion targets can be utilized because only the paracentral areas of the macula can be developed for fusion. Not until large fusion targets are readily fused should the smaller duction training cards in the EC series be used. Macular aversion to fusion becomes an annoying factor should the smaller targets be used too early in training.

This method of squint training is not foolproof. By no means can you expect to cure every squinter who is referred to your office. Age is an important factor, especially where anomalous projection exists. Anyone past the age of 21 and under the age of 7 is a poor risk. If the initial steps of eliciting gross spatial perception and the proper development of normal replacement can be accomplished, the rest of the program still may develop. Of course the existence of any slight paresis is a distinct handicap to complete parallelism. Should a paresis exist operative procedure may be resorted to after proper projection and good stereopsis and diplopia have been developed. The surgeon should overcorrect these paretics without fear of an opposite squint, providing normal projection fusion and stereopsis exist. For a while after operative procedure, training must be continued in order to consolidate the gains made through the operation.

It would be foolhardy to predict the time required to correct any case of squint. However, experience has proven that exotropes respond more readily to training than the esotropes. Vertical tropias are generally referred for operative procedure soon after corrective projection training.

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SUBNORMAL VISION DUE TO KERATOCONUS CORRECTED WITH CONTACT LENSES—A CASE REPORT*

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CASE HISTORY

Patient, male, age 22.

Ocular history: Eyes seem to have been perfectly good until three or four years ago when the patient noticed he had difficulty in seeing with his left eye. His left eye gradually became worse and then his right eye started to indicate a reduction in vision. Patient then visited a local oculist who diagnosed the condition as conical cornea. This specialist prescribed lenses and had the patient visit his office once a year to have the lenses checked. Each visit required a different prescription. Two years after the patient noticed his difficulty, his left eye could not be improved with lenses. His right eye gradually became worse, although he still had fairly good vision. The local specialist saw the patient in February, 1946, and at that time suggested he get contact lenses. The patient had never had an ocular injury that could have affected his eyes.

Health history: Measles, chicken pox and influenza.

Family history: The mother's eyes are apparently good. His father has an amblyopia in the right eye. A brother wears a small correction. His sister's eyes are apparently good. No history of keratoconus in the family.

School history: Good student in school. Eye condition developed after his graduation from high school and therefore did not interfere with him scholastically.

Social and recreational history: Well adjusted individual. His eye condition was accepted without undue mental depression. Occupation: commercial builder.

PRELIMINARY FINDINGS

External examination.

Lids: Cilia heavy, conjunctiva smooth.

Superficial cornea: Cone shaped O.D. and O.S.

Superficial sclera: Normal.

Versions: Good.

Rotations: Good.

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Pupillary reaction to light—Direct: Normal; consensual: normal.

Pupillary reaction to accommodation: Normal

OPHTHALMOSCOPIC EXAMINATION (Direct)

Because of the corneal distortion I could not examine the eye ophthalmoscopically in the usual manner. However, by putting a plano contact lens in place, to reduce the corneal distortion, I was able to get a fair view of the fundus

Findings (with plano contact lenses):

Cornea:	Clear. O.D. and O.S.
Aqueous:	Clear. O.D. and O.S.
Lens:	Clear. O.D. and O.S.
Vitreous:	Clear. O.D. and O.S.

Fundus: Generally pinkish, condition good.

Disc: Margin well defined, physiological cupping present.

Course of arteries and veins straight.

Proper arterio-venous ratio. Venous pulsation present.

Macular reflex present.

ANALYTICAL EXAMINATION

Visual acuity (without correction)	O.D.	20/40
	O.S.	Light vision
	O.U.	20/40
Visual acuity (old Rx)	O.D.	20/30
	O.S.	Light vision
	O.U.	20/30
Visual acuity (contact lens)	O.D.	20/20
	O.S.	20/25
	O.U.	20/20

Ophthalmometer: Badly distorted mires.

Retinoscopy: No finding because of distortion.

Subjective: O.D.—1.50 D. sph. ⌒ + 0.75 D. cyl. x 70. O.S.. no finding

Binocular tests: Having only light vision in the left eye it was not possible to take binocular tests.

Color vision: Normal.

Fields: Form fields normal

DIAGNOSIS

Patient has a definite keratoconus with the left cone more advanced than the right

RECOMMENDED TREATMENT

Fit the patient with contact lenses to improve vision. and also in-

hibit the advancement of the condition.

RESULTS

Patient fitted with contact lenses which enabled him to have excellent vision in the right eye and good vision in the left.

He wears his lenses all day except for an interval of approximately one hour around dinner time. After approximately four hours a haze, and also rainbows around strong lights appear, due to the absorption of buffer solution into the cells of the corneal epethelium. The patient has made a mental adjustment to this behavior pattern of contact lenses and wears them in spite of the above without any undue difficulties or effects.

COMMENTS

Some ophthalmologists have attempted to inhibit the advancement of conical corneal by means of cauterizing the tips of the cornea. From a visual standpoint this procedure accomplishes very little.

I believe most practitioners today feel that contact lenses are the best form of aid to keratoconus patients.

Once the choice of contact lenses is made the doctor should then begin to study the optical and fitting effects of various lenses in order to select that lens which performs the function best. Various manufacturers put out lenses that have individual advantages and disadvantages.

The most important factor to be concerned with in fitting a keratoconus patient is that the apical clearance must not be too great. The reason for this is that the apical clearance results in too great a lag, excessive absorption of light due to a thick water lens, increased aberration during rotations from seeing through the edge of the optic, chance of induced prism from difficulty in centering, and poor cosmetics due to bulge.

Unfortunately most contact lens laboratories produce contact lenses for keratoconus patients that contain too much apical clearance with the resultant disadvantages already mentioned.

With this in mind, I designed my own lens for this patient and had it machined so that the apical clearance was .0012 of an inch. I had to take impressions in order to accomplish the type of fit I desired. If I had used a trial case method I could not, of course, have determined the exact extent of apical clearance.

The final lens this patient is wearing is well centered, shallow and cosmetically good.

SUMMARY

This patient had been under the care of an oculist for several years.

He was suffering from keratoconus and had been using glasses to correct his failing vision. Contact lenses were suggested and prescribed, bringing vision to near normal in the left eye which heretofore had had light perception only.

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DEFINITION AND MEASUREMENT OF CYCLOPHORIA WITH CONVERGED AND ELEVATED LINES OF SIGHT*

SPECIAL REPORT NO. 3
COMMITTEE ON NOMENCLATURE AND STANDARDS
AMERICAN ACADEMY OF OPTOMETRY

Glenn A. Fry, Chairman
C. L. Treleaven, Rita Walsh, E. L. Higgins, and C. A. Radde†

INTRODUCTION

A number of devices for measuring cyclophoria provide for various degrees of elevation of the plane of regard and for various degrees of convergence of the lines of sight, but the different devices employ different systems of axes for changing the elevation and azimuth of the targets.

It is desirable to adopt a standard method of defining cyclophoria so that cyclophoria data obtained with different types of instruments can be reduced to a common denominator. The committee has not been able to find evidence that anyone has attempted to formulate a standard definition of cyclophoria for converged and elevated lines of sight, expressed in terms of lines, points and planes which are fixed with respect to the head and eyes. Investigators who have been concerned with this problem have simply presented their data in terms which apply directly to the apparatus used.

In previous reports[1, 2], this committee has defined lines, points and planes which are fixed with respect to the head, and which provide the necessary basis for defining cyclophoria for elevated and converged lines of sight.

DEFINITIONS

In measuring cyclophoria, one presents a linear target to each eye without permitting fusion, and intorts or extorts one of them until the two images appear parallel. It is then assumed that the two targets lie in corresponding meridians.

If we use the symbol η to designate the dihedral angle between the target meridian and the plane of regard, and measure it in a clockwise direction from the plane of regard to the meridian in question, and if we define clockwise as the direction of the movement of the hands of a

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clock that the eye is facing, we may define cyclophoria as the difference between the η value of the target meridian of the right eye and the η value of the corresponding meridian of the left eye.

$$\text{Cyclophoria} = \eta_R - \eta_L. \quad (1)$$

Positive values represent excyclophoria and negative values incyclophoria.

When the η value for one eye is close to zero and the other is close to 180°, 180° must be added to the η value close to zero.

Since cyclophoria may vary for different meridians, the absolute value for η for at least one eye must be specified, in addition to the cyclophoria, whenever meridional differences in cyclophoria have to be taken into consideration.

The plane of regard of either one of the two eyes is defined without reference to the other eye as the plane containing the line of sight of that eye and the base line connecting the centers of rotation of the two eyes. The planes of regard of the two eyes coincide when the lines of sight converge to a common point. However, in many situations one line of sight may be elevated more than the other.

In the subsequent sections of this paper, an attempt is made to show how this definition of cyclophoria can be made to apply in the measurement of cyclophoria with two types of instruments exemplified by the clinoscope and the synoptiscope.

THE CLINOSCOPE

In the case of the clinoscope[3], the axes of rotation for changing the azimuth and elevation are such that the horizontal meridian of each tube always corresponds to the plane of regard, and the clockwise

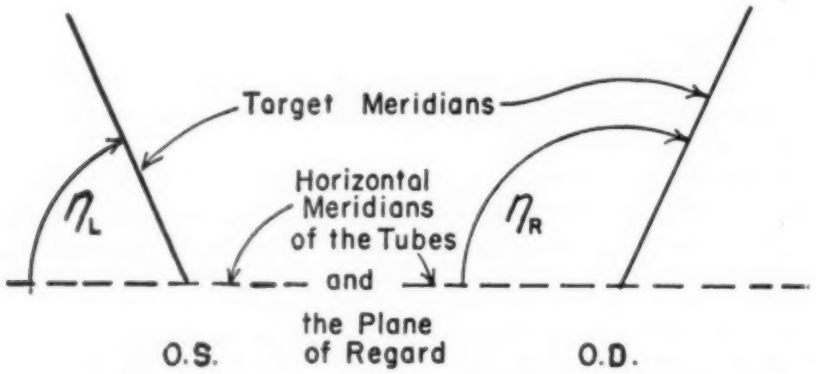

Figure 1. Angles involved in computing cyclophoria from measurements made with the clinoscope.

angular deviation of the target meridian from the horizontal meridian of the tube actually represents the angle η in equation (1). See Figure. 1.

When the clinoscope is used, the instrument must be levelled and the head must be adjusted so that the face plane is vertical, and the base line is horizontal and so that the axes of the tubes pass through the centers of rotation.

THE SYNOPTISCOPE

In the case of the synoptiscope[4], the arms supporting the target tubes rotate around vertical axes, and each tube rotates about a horizontal axis perpendicular to the axis of the tube and which is fixed with respect to the arm supporting the tube. The zero meridian of each tube undergoes torsion when the elevation and azimuth are changed and allowance for this torsion must be made in calculating the amount of cyclophoria.

The amount of torsion of the tube may be defined as the acute angle (ω) between the horizontal meridian of the tube and the plane of regard. An equation for calculating the amount of torsion may be derived as follows:

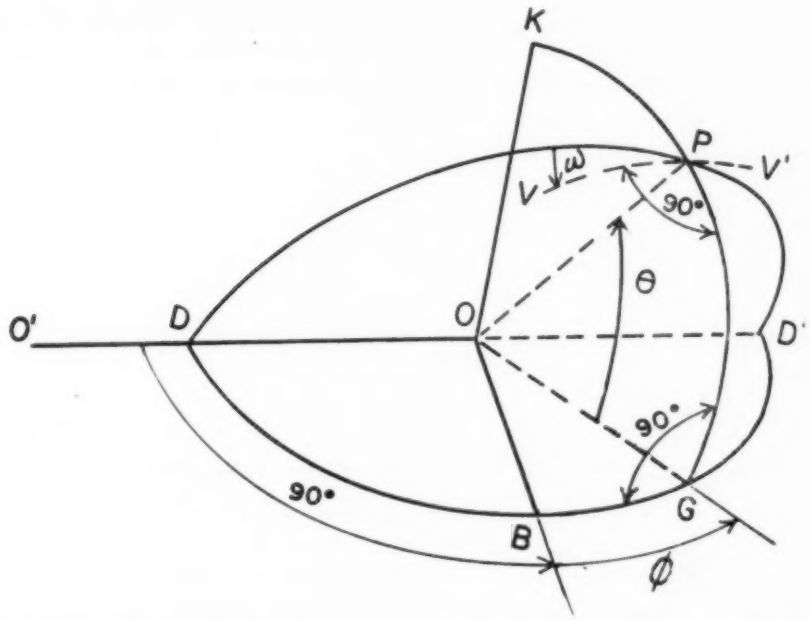

Figure 2. Geometry involved in computing an allowance for torsion of the tubes in cyclophoria measurments made with the synoptiscope.

In Figure 2, O represents the intersection of the horizontal and

vertical axes around which the left tube moves, and O′ represents the corresponding point for the right tube. OK represents the vertical axis around which the main support of the left tube rotates. Starting with the axis of the tube in the straight ahead position (OB), one can rotate it to the position OG around the vertical axis OK, and then rotate it to the position OP around the horizontal axis which is then perpendicular to the plane OGK. The horizontal meridian of the tube VV′ is still perpendicular to the plane OGK but is "torted" through an angle (ω) from the plane of regard (DPD′). Since DPG is a right spherical triangle,

$$\cot (90 + \omega) = \cot (90 + \phi) \sin \Theta. \quad (2)$$

The angles ϕ and Θ represent the angles of longitude and latitude for the point P. Equation (2) reduces to

$$\tan \omega = \tan \phi \sin \Theta. \quad (3)$$

Counterclockwise torsion occurs in the "up and right" and "down and left" positions of the tube and clockwise occurs in the "down and right" and "up and left" positions. In the following equation clockwise torsion is treated as positive and counterclockwise torsion as negative.

If we use the symbol γ to define the clockwise angular deviation of the target meridian from the horizontal meridian of the tube, the value of η for either eye is given by the following equation:

$$\eta = \gamma + \omega. \quad (4)$$

The relationships existing between η, γ, and ω are illustrated in Figure 3.

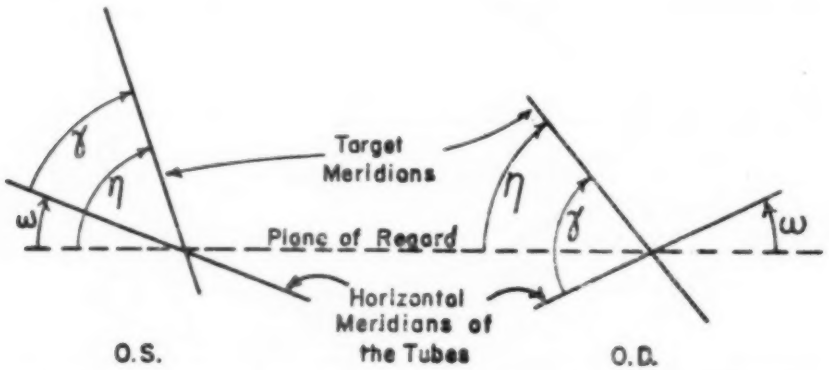

Figure 3. Angles involved in computing cyclophoria from measurements made with the synoptiscope.

When the synoptiscope is used, the instrument must be levelled, and the head and interocular adjustment must be adjusted so that the

centers of rotation fall at O and O′ and so that the face plane is vertical.

SUMMARY

A definition of cyclophoria has been formulated which applies to all possible conditions of elevation and azimuth of the lines of sight.

The clinoscope and synoptiscope have been used to illustrate the application of the recommended definition of cyclophoria, and especially to illustrate how the definition makes it possible to reduce the cyclophoria data obtained with two different types of instruments to a common denominator.

Other types of devices are available for the measurement of cyclophoria, but it is believed that the clinoscope and synoptiscope suffice to illustrate the basic principles.

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ORTHOPTIC TRAINING TO IMPROVE THE VISUAL ACUITY OF A MYOPE—A CASE REPORT*

Albert J. Rowe†
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J. F., 17, a student, consulted me for refraction on May 2, 1947. Patient desired to improve unaided visual acuity so that he might get into the naval reserve. Unaided visual acuity O.D. 20/200 O.S. 20/200.

Refraction:

O.D.—1.75 D. sph. ⌒—0.75 D. cyl. x 90. V.A.=20/20
O. S.—1.75 D. sph. ⌒—0.75 D. cyl. x 90. V.A.=20/20

The naval requirements as applied to this case are: minimum monuclar acuity of 6/20; minimum binocular acuity of 10/20.

Patient referred to Cleveland Contact Lens and Visual Center for visual training. A program was set up with visits scheduled four times weekly for a period of six weeks.

PRESENT STATUS

Patient was accepted into the United States Naval Reserve on May 22, 1947. Uncorrected visual acuity on June 14, 1947, was O.D. 20/40 O.S. 20/40. O.U. 20/40+. This acuity permits patient to perform routine tasks to his satisfaction without glasses.

COMMENT

It should be noted that training was not instituted to reduce myopia but rather to increase acuity. There was little refractive change but perception as recorded on all types of charts was increased significantly. Subjective reports also indicate that general perception (other than acuity charts) was proportionally benefited. Results and motivation were sufficient to accept this case on the basis of an improvement of visual acuity.

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A NEW LIGHT WEIGHT AND UNBREAKABLE PLASTIC OPHTHALMIC LENS*

Robert Graham†
Pasadena, California

The earliest known lenses were probably of crystal, such as the tea-stone lenses of the early Chinese, and Nero's famous gazing-emerald, which presumably enabled him to view the burning of Rome with a great deal of comfort. But with the possible exception of these early beginnings spectacle lenses down through the centuries have been made of glass.

As a result, when we think of lenses we think in terms of glass. We are so accustomed to regarding glass as the only available material that ophthalmic lenses customarily are spoken of as glasses. Having no alternative, we have accepted, almost without question, the fact that glass is a heavy solid; that it is brittle and that, in fracturing, it forms jagged, dangerous shapes with keen edges. Glasses are fragile and when broken on the face, change suddenly from a benign visual aid into a vicious threat to the very eyes they were worn to help.

Although we have lived in the age of glass optics, we are aware that organic chemists have made brilliant strides in the field of plastics. So it does not come as a complete surprise when one learns that glass no longer has a monopoly in the field of optics; and that developments in plastics have reached the point where the properties of some of them excel in several respects those of glass. We regard it as logical and inevitable that this should occur. We accept with pleasure the news that we have been given excellent new optical substances.

Optics made from these materials look exactly like glass lenses, and check as accurately on measuring instruments. The water-white lenses have a crystalline elegance to them, and do not yellow with age. The green lenses also are color-stable and as handsome as the finest ophthalmic green glass. Striae, bubbles and deep inclusions are practically unknown. There is excellent retention of form under any temperature which the wearer can endure. They show less internal haze and scatter than even the best glass. In most respects they are the

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†Optometrist. Fellow, American Academy of Optometry. Director of Research, the Plastic Optics Company of America.

equal of glass lenses and in several ways are superior to them.

Ophthalmic lenses made of optical plastics have a light-transmission factor of 92 per cent, hence are more transparent than glass lenses. They are somewhat thinner because the minimum thickness can be less. They are over four times as resistant to fogging as glasses are. With a specific gravity of 1.2 against 2.5 for glass they are less than half the weight. They have such tremendous impact strength that they are practically unbreakable. They will withstand a blow which would shatter ordinary glass and reduce laminated glass to crackled translucence. They are very nearly accident-free. This is a telling array of advantages in a lens. The writer believes that few patients who have experienced the lightness of plastic lenses and the feeling of safety which goes with wearing them, will ever willingly revert to glass lenses.

Plastic lenses did exist briefly prior to the war, and were a limited success. However, they lacked color- and thermal-stability and consequently yellowed with age and warped in hot weather. More than that, their great drawback was damage from cleaning. Wiping with even a soft cloth would abrade the surface, introducing fine hairlines which of course accumulated with each cleaning. The makers supplied a paste to minimize this, but the average lens life was brief.

However, plastics developments during the war were swift, and as a result we now have lenses which remain crystal-white, are heat stable and hard as aluminum. This is not so brittle-hard as crown glass. But it is hard enough so that the lenses may be cleaned repeatedly without scratching or otherwise injuring the surfaces.

These are the accomplishments above and beyond previous plastic lenses: they are now fine optically, are color-free, stable under heat and will endure cleaning and other ordinary treatment for a long and satisfactory period. The first of these lenses are still in excellent condition after more than nine months of constant wear. If given simple, intelligent handling, and not thrown about to startle others, lenses of plastic now offer very good wearing time. As a matter of fact, with both the breakage of glass and the cleaning damage of earlier plastics done away with, it is now for the first time possible to assure patients of substantial service from their lenses.

The assertion is not made that, under the same care, these lenses will last as long as a pair of glasses which escape breakage. Under certain conditions such as sand-blast, flying particles from abrasive wheels and sparks from welding, their resistance to abrasion is many times that of glass. But in spite of great toughness they are not indestructible.

Under ordinary circumstances their resistance to abrasion is not so great as that of glasses, for they do not have the brittle hardness which makes glasses so fragile. Except where glasses are broken frequently, plastic lenses have to be replaced more often. That, however, is simply a matter of increased maintenance cost, and is economically justified, for patients receive increased comfort, service and safety. They will not be suddenly deprived of their lenses as they are when glasses break. Their eyes will be protected instead of subject to the hazard of broken glass. In addition they get great lightness. All these are very real advantages. They permit lenses which, while costing more than those of glass, in some respects, surpass them as visual aids. A chief advantage remaining to glass lenses is that they are cheaper to buy and, as a rule, to maintain.

Single-vision plastic lenses are now available on prescription. They constitute a significant addition to the optometric armamentarium and a wholesome influence on the optometric economy. A new way to serve and care for visual needs has come into existence.

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A DETERMINED AND UNITED OPTOMETRY

As a nation we find ourselves divided by creed, race, sectionalism, occupation and class, but in spite of these things there is a rare pattern of solidarity in American life which binds us together as a people.

This is true, too, in optometry. We have the professional practitioner, the optometrist in commercial quarters, and those whose practice is a mixture of both. We have those who follow the theories and instructions of the O. E. P. and those who follow the orthodox teachings of the past. Yet underlying these differences, optometrists stand firmly together in all periods of crisis and unite whenever an adversary appears.

As a nation we are a strange combination of similarities and differences. We bathe with the same advertised soaps, brush our teeth with the same brands of toothpaste, gargle to rid [?] ourselves of the same well advertised germs, and daily across this land we sit down to the

same brand of bacon and breakfast foods. We have our offices on a Main Street that looks just about like every other Main Street. We read the same syndicated columns and laugh at the antics of the same radio comedians. Despite this standardization, however, there are many differences between us as Americans.

Politically Americans vary from reactionary extreme right to the apex of radicalism on the left. Our vocabulary changes as different parts of America are visited. Our economic outlook varies from one part of the country to another and there are differences in viewpoint between the urban and rural dwellers. Yet through all these differences there is still the characteristic American note of unity and optimism—a spirit which overcomes defeat. No matter how dull the economic skies may be for the moment, tomorrow will be brighter and we will be well on the road to another fortune.

In optometry there is the same note of unity. We are all interested, as optometrists, in the proper correction of visual problems. We generally prescribe glasses to correct these problems. We believe we can do this work properly without cycloplegics. We believe, too, that orthoptic procedures have their rightful place as adjuncts to our ocular prescriptions for glasses. And despite this standardization there are many differences between optometrists.

We differ on the interpretation of findings. We are by no means a unit on the correction of myopia, some undercorrecting and others prescribing full corrections; we do not agree on the value of prismatic corrections; or on the correction of the unequal sized images known as aniseikonia; or on the value of contact lenses and the best way to fit them. Also, we are by no means of one mind on how to spread our fees and charges. All these and many more differences exist despite the rather uniform pattern of optometric education and the long-term experiences of the past.

Because of these differences the outside world sometimes is given the impression that we are being drawn in so many different directions that we are not moving ahead at all.

This is far from the truth. As a professional group we are making excellent progress in spite of these normal and healthful differences. The advancement made by optometry as a group in the last two decades represents one of the foremost professional developmental strides ever accomplished in a short period in the world's history. This advancement covers both the technical and practice phases of our professional work and will continue at an accelerated pace in the future.

Despite the differences of opinion between optometrists, the group as a whole stands united in its insistence that there be no federal or local interference in its full right to professional status and participation in all public health programs as these relate to the eyes. As a profession, optometry will brook no interference on the part of well lobbied minorities or overawed government departments which may attempt, because of pressures, to overlook the part optometry is here to play in the health program of America.

Differences there may be, but despite these, the profession is united as never before and faces the future with the confidence which comes from the knowledge it is properly serving the American public.

CAREL C. KOCH

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

ANNOUNCEMENT OF ANNUAL MEETING

Memo to Academy members: Have you blocked off December 13-16 on your appointment sheet? Have you made a room reservation at the Palmer House, Chicago? Have you made travel reservations to Chicago?

That's all Academy members have to do to get ready for the 1947 annual convention and there is still ample time to make these simple arrangements to attend.

Dr. Harold Simmerman, program chairman who has been working steadily since the Philadelphia meeting in May, reports excellent progress on program arrangements for the Chicago meeting. In addition to speakers for the section meetings (contact lens, aniseikonia, orthoptics), the following men will present papers:

Dr. Glenn A. Fry, School of Optometry, Ohio State University, Columbus, Ohio; Dr. Roy Marks, Univis Lens Company, Dayton, Ohio; Dr. Charles S. Bridgman, School of Optometry, Ohio State University; Dr. Norman B. Hays, 717 Main Street, Niagara Falls, New York; Dr. Julius Neumueller, 320 Rhoads Avenue, Haddonfield, New Jersey; Dr. J. Donald Kratz, 158 Washington Avenue, Souderton, Pennsylvania; Dr. Paul Boeder, American Optical Company, Southbridge, Massachusetts; Dr. J. S. Nupuf, 1342 North Cleveland Street, Canton, Ohio; Dr. Herbert G. Mote, 8 East Long Street, Columbus, Ohio; Dr. Mathew Alpern, 12 Leader Building, Cleveland, Ohio; and

Dr. Ralph E. Wick, Rapid City, South Dakota.

Topics chosen by these men are not as yet available for publication, but Dr. Simmerman promises a full report on the program for the November issue.

BRING YOUR APPETITE

Where to eat is always a problem at a convention. Time between lectures is short, and too often, many do not know where good restaurants in a city are located. In an attempt to correct this problem for Academy members, our Editorial Assistant, Virginia Huck, is now in the process of communicating with certain Chicago dwellers who do a great deal of eating out in that city, requesting recommendations on where to find good food in Chicago. From preliminary results of her "survey" it looks as though Academy members will be able to get at least some idea of where good restaurants are, and their proximity to the Palmer House. So look forward to getting a "restaurant guide" along with your Academy program when you register Saturday morning, December 13!

We'll be reminding you of this again, but just for the record, the banquet this year is on Monday night, and will be formal.

NEW MEMBERS OF THE ACADEMY

The following optometrists, educators and scientists were elected to Fellowship in the American Academy of Optometry during the quarter ending September 30, 1947. The Executive Council welcomes these new members.

Dr. Harry C. Armstrong, 511 Robeson Bldg., Champaign, Illinois.
Dr. T. E. Donoghue, 116 W. Nash St., Wilson, North Carolina.
Dr. Ralph L. Dublin, 68 Lapham Park, Webster, New York.
Dr. Donald F. Ellis, 9 Masonic Bldg., Houlton, Maine.
Dr. Leon Firestone, 16101 Harper Ave., Detroit, Michigan.
Dr. Ralph H. Green, Dean, Massachusetts School of Optometry, 285 Huntington Ave., Boston, Massachusetts.
Dr. T. E. Holleman, 505 O'Hanlon Bldg., Winston Salem, North Carolina.
Mr. Fred W. Jobe, Bausch & Lomb Optical Company, Rochester, New York.
Dr. Carl A. Kauffman, 144 No. Main St., Suffolk, Virginia.
Dr. Harold I. Moskowitz, 2302 Washington St., Wilmington, Delaware.
Dr. Edwin H. Reese, Medical Arts Bldg., Glens Falls, New York.
Comdr. J. Howard Steeve, H (s) USNR, U. S. Naval Medical Supply

Depot, Pearl and Sand St., Brooklyn, New York.
Dr. Henry L. Wolfe, 415 Masonic Temple, Marshalltown, Iowa.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

A WRITER'S IMPRESSIONS WHILE GETTING CONTACT LENSES

A prescription for a pair of contact lenses is a deceptive piece of paper. To the visually deficient patient the printed form filled with unintelligible letters and figures is the key that opens the door to a clearer, brighter world. To the doctor, it is the pattern for the key-maker. But to neither patient nor doctor does the small sheet of paper reveal the years of research and months of painstaking work that made it possible to translate "12.5/8. —5.25 O.D., 12.5/8. —5.75 O.S." into a pair of useful contact lenses.

The real story of a contact lens is to be found in the fitting room and in the laboratory and in the minds of those who have spent long weary hours in research—a story I found when I followed my own contact lens prescription through the intricate fitting and manufacturing process.

The first stop in my journey was the fitting room of the N. P. Benson Optical Company for the initial fitting.

Before reporting for this fitting I had debated whether to have the eye impression made with or without anesthesia. I had read articles describing both methods. Being a little apprehensive, I finally decided on having an anesthesia.

I'm not sure just what I expected to happen to me during the molding process. I had seen pictures in magazines and books of contact lenses being fitted and had read a number of our technical articles written by optometrists. In both the pictures and magazine articles the procedure looked complicated and uncomfortable for the patient. I guess I expected a rough time. I had a notion that moldite was a substance similar to plaster of Paris and that as it dried, rough particles would break off and scratch my eyes. I couldn't quite figure out (in spite of all the pictures I had seen) just how the moldite could be removed without a great deal of trouble once it became fixed to my eyeball. I expected the anesthesia to blur my vision.

When discussing the subject with my friends, I noticed that they, too, involuntarily shuddered at the mention of the words, "contact lens."

Now I can tell them to forget their fears, for I found the experience unbelievably simple, and not too unpleasant.

True, the anesthesia (pontocaine in this case) felt like a good dose of soapsuds, but only for a few seconds. And while fixation on the target was difficult at first because of the tears caused by the anesthesia, it was only a few moments before fixation with ease was possible.

After a second application of pontocaine in my right eye, and what appeared to be a silver-grey object was waved in front of the eye (the anesthesia was being tested and a wisp of cotton was actually touching my cornea), the moldite was placed on the eyeball. Aside from a sensation of coolness akin to menthol on the skin, there was no feeling when the moldite was applied.

The molding was accomplished so quickly and easily I really had no time to become apprehensive. What little nervousness I experienced was just before the impression was taken of the left eye, probably because I was anticipating the sting from the drops of pontocaine. However, the nervousness disappeared as soon as the moldite was placed on the left eye.

After impressions were taken of both eyes, the excess moldite was removed (I had discovered by now that moldite has the consistency of hard-boiled egg white and can't scratch), and the red pencil marks placed on my nose and cheeks to mark proper axis position were erased. Positive molds of the negative moldite impressions were then cast and these molds sent to the laboratory along with the prescription. My eyes had already been examined with and without trial lenses by Dr. Carel C. Koch.

The Laboratory Process

In the large, airy sixth floor laboratory of Precision Contacts my prescription began its journey from department to department.

Exclusive of administrative work there are three basic steps in making the lens: molding; grinding and polishing in the "optics," and the scleral polishing. During the process, the prescription serves as a constant guide to the worker.

Molding: A duplicate positive mold is made of the original cast taken at the initial fitting. This duplicate is used to transform a small disc of sheet plastic into the required lens shape.

Grinding and polishing in the "optics": In the second step, the cor-

rection is ground and polished in the corneal section of the rough lens. At this stage the lens is checked with an ophthalmometer to eliminate possible cylinders, and the lens power is checked against the prescription with the aid of a vertometer. If the power is correct, the corneal section is again polished inside and outside, and the lens is then ready for final buffing.

Polishing: In the last step, scleral and corneal sections are buffed with soft cloth buffers.

Inspection is a ritual rather than a routine. After each of the three basic steps the lens is inspected for imperfections in the plastics, correct lens power, proper curvature, thickness, and scleral size. "The lens is inspected after each step to prevent completion of a lens which wouldn't pass one final test," Albert L. Anderson,[2] head of the scientific division, explained, as we watched the chief inspector examine a lens. "Often we can correct an imperfection, but sometimes it is necessary to reject the lens after a preliminary inspection, so periodic checking saves time in the long run."

Precision and perfection are the twin watchwords of every employee. "Sometimes it is difficult at first to impress upon a new employee the importance of absolute accuracy and the fact that a contact lens is not an ordinary factory job," Mr. Anderson admitted.

But many of the 60 present employees needed no convincing that accuracy is of prime importance. Physically handicapped themselves,* they realize a man-made aid often has a value far beyond its material cost, and the more perfect it can be made, the more it may add to human happiness.

Imperfections in glass contact lenses and cut-off of foreign supplies prompted Mr. Anderson to experiment with plastic lenses in his own basement in the late 1930's. However, basement facilities soon proved inadequate for the big job of perfecting his lens, and in 1942, the company was formed.

High myopia, scarred corneas, keratoconic corneas—in fact, any defect in vision which he believes might be corrected by a contact lens challenge Mr. Anderson, a quiet, earnest man in his middle thirties who has devoted years of study toward improvement of ophthalmic lenses, contact lenses and artificial eyes. "Wearing comfort of a contact lens is no longer a problem," asserts Mr. Anderson. "The main thing

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[2]Optician and ophthalmic lens designer.

*Precision Contacts is noted throughout Twin Cities for its willingness to employ handicapped persons. A total of 30 is now on the payroll.

that bothers a patient now is veiling or clouding which cuts down wearing time."

Mr. Anderson believes that while contact lenses are primarily visual aids, their possibilities for other uses, such as cosmetic aids, should not be overlooked. Using both original thinking and ideas already developed in the field, considerable experimenting has been done with tinted lenses for screening out excessive light (used extensively by skiers); lenses with the scleral portion opaqued to cover scarred tissue, and a lens designed for albinos which has an iris painted on to simulate natural coloring, to name only a few. Secret service agents occasionally request a set of lenses for disguise purposes.

Eye Making

While watching them make my contact lenses, I found both custom and stock artificial eyes being manufactured in the same laboratory as the lenses. Here again the need for accuracy is instilled in each worker —anatomical in this case, to insure the artificial eye matching as nearly as possible the patient's good eye.

Anatomical perfection in the early days of plastics was a continual headache. Plastics and paint didn't mix and the plastics was not as yet dependable. In 1944, the research department called in as color consultant, blonde, brown-eyed Laura Bruce, a Minneapolis girl then teaching art at North Park Junior College, Chicago. For many weeks, Miss Bruce, in cooperation with the others in the research department, worked on the color problem. At first the colors bled, swam, and were generally incompatible with plastics. Eventually, however, the present-day process was worked out and the artificial eye now has a very natural appearance.

Miss Bruce's duties are now anything but routine,and her background as artist and teacher has proved very valuable to her co-workers. Along with Dr. Charles Sheard of the Mayo Foundation, Rochester, other professors from the University of Minnesota, and Mr. Anderson, she teaches two classes at the laboratory (History of Contact Lenses and Fitting of Artificial Eyes). She also supervises the staff artists, writes most of the company's advertising copy, and has recently started editing a monthly bulletin sent to doctors.

"I always wanted a job where I could see the results of my efforts," Miss Bruce said. "When I was teaching a new crop of freshmen artists each year I never had a chance to watch them progress with their careers. Here I can see the finished job."

Recognizing that human eyes, like fingerprints, all differ in size,

contour and color, these technicians set to work to not only be able to tailor an eye, but to make a set of stock eyes that would, through ingenious application of plastics, provide ample selection for those unable to afford a custom made eye.

Demands upon the laboratory are sometimes unusual, but the workers usually can rally to the occasion. For example, occasionally a cracked and splintered glass eye will come in with an order requesting a plastic replacement. "We paste the pieces of the broken eye together to serve as a model, and do our best to match it—and usually can," Miss Bruce related.

The process of manufacturing the eyes is similar to that of the contact lens. The eye is molded, polished, the iris "button" inserted, and blood vessels added. It is rigidly inspected for flaws in the plastics, proper size and color as specified in the prescription sent in by the doctor.

In all, four types of plastics are used for the lenses and eyes—sheet, granulated, liquid, and dough. Although plastics has been perfected to a degree once believed impossible, research continues. Experiments are constantly conducted in the special large plastics "kitchen" in an effort to improve the quality of the finished product.

My Contact Lenses Are Finished

The laboratory technicians had now completed my lenses and I reported for a final fitting and instructions in their use. Having already been introduced to the strange sensation of a lens, I did not wince quite as much at this fitting when I saw the liquid filled lens moving toward my eye. However, I still squirmed considerably when the lens was placed under my lids. Gradually, after the fluorescein test and fittings were made to determine necessary adjustments, my eyes became more used to the foreign objects in them, and accommodation—quite difficult at first—became much easier.

After the final adjustments I started learning how to insert the lenses myself. I had anticipated being all thumbs but found insertion was not difficult and I mastered the technique without too much trouble.

I now have contact lenses. The newness and strangeness have worn off. I find these aids much more pleasant to wear than I thought they would be. In my opinion, our optometric authors have been most conservative in their comments. Now that I have had this interesting experience I am going to have the lenses fitted once again, this time without anesthesia, using the alternate optometric technique of molding. Judging from this experience, I feel sure that molding without anesthesia

will be just as free from discomfort, and the results as satisfactory.

To me, the whole new science of contact lens making and fitting seems an interesting field full of worthwhile developments, and I envy optometrists their opportunity of creating and prescribing these new visual aids in addition to the glasses and orthoptics which historically they have prescribed.

REMINISCENCE BY SOUTHALL

A bit of philosophy, some sage observations on modern education, delightful stories of the South during the 1880's—these are the ingredients of Dr. James P. C. Southall's heart-warming book, "In the Days of My Youth." (University of North Carolina Press, $3.00).

Sedately, but humorously, Dr. Southall relates the events in the days of his youth beginning with a moonlight hayride in Goochland County, Virginia, and ending with graduation from the University of Virginia.

Students and friends of Dr. Southall will undoubtedly find the book of interest, but there is also much in it which will be of interest to others not fortunate enough to know the distinguished author.

Today's college students will find Dr. Southall's observations on education wise and sound in judgment: The study of literature is "the corner stone and foundation of a useful and sensible education." Through the study of the Greek and Roman classics a student can, "under the guidance of sympathetic and enlightened teachers, gain poise and reasonableness unattainable by any other process of training." "The character of a great university rests above all on the character and quality of the teachers."

For the general reader there are amusing tales of Dr. Southall's escapades in college; for optometrists, educators and scientists, stories of antics during classes in mathematics and physics which will rouse memories of similar incidents in their own life in college.

But these are only the highlights of the book. We leave the formal reviewing of the book to Dr. Robert E. Bannon, who knows the author and his former writings. Dr. Bannon's review will be in the Journal under our "Book Review" department in the very near future.

BOOK NOTICES AND REVIEWS

Books received are acknowledged by notices in this department. Special selections will be made for more extensive review in the interest of our readers as space permits.

MATHEMATICAL ANALYSIS OF BINOCULAR VISION. Rudolph K. Luneburg.* Published for the Dartmouth Eye Institute, by the Princeton University Press, Princeton, New Jersey. 104 pages. Illustrated. Board covers. $2.50. 1947.

This treatise may well become the foundation for a new concept of binocular vision and space perception. It has promise of providing a "measuring stick" for our visual space sense and may be of great importance to those interested in orthoptics and visual training as well as contributing to our knowledge of binocular vision in general.

Your reviewer does not purport to be sufficiently competent to present from an academic standpoint an adequate discussion of Luneburg's work. However, this brief and incomplete presentation is offered primarily to bring the reader's attention to Luneburg's important work and it is hoped that in the not too distant future, someone will do justice in reviewing this paper in a more comprehensive fashion.

Luneburg's investigation has resulted in a mathematical theory of binocular visual perception. Heretofore, the orthodox geometric explanation of three-dimensional localization of objects in space has been by the classical projection theory of binocular vision whereby a point in space is represented by the intersection of two projection lines (optical axes) drawn from base points, such as the centers of rotation of the eyes. This method has served its purpose well in teaching and for the elucidation of many visual phenomena. However, it does not always give a "true" picture, i.e., some of our actual visual sensations of form and localization do not conform to this construction.

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*"Luneburg, Dr. Rudolf K(arl), Spencer Lens Co., 18 Doat St., Buffalo, N. Y., Mathematics, Physics. Volkersheim, Germany, June 30, '03. Ph.D., Gottingen, '30. Research Assoc. Math., Gottingen, '30-33; Research Fellow Physics, Leiden, '34-35; Research Assoc. Math., N. Y. Univ., '35-38; Mathematician, Research Dept., Spencer Lens Co., '38-. Math. Soc. Mathematical Theory of Probabilities; geometric and physical optics."—p. 1100, Am. Men of Science, 7th Ed., The Science Press, Lancaster, Pa., 1944.

Dr. Luneburg is also the author of Mathematical Theory of Optics (with supplementary notes by M. Herzberger), Brown University, Providence, R. I. At the present time (1947) Dr. Luneburg is a faculty member of New York University.

Luneburg posed the problem as follows:

> "To find a coordination of the sensed points of a visual sensation to the points of a geometrical manifold such that the apparent distance of any two sensed points is always proportional to the geometrical distance of the correlated points."

As Luneburg points out, such a coordination is called a *psychometric coordination* and certain basic psychological facts are presented which indicate that a psychometric coordination is possible in the case of the visual sensations. Furthermore, Luneburg proves that a geometric manifold can be determined in which there will be a psychometric map of visual sensations providing the possibility of measuring in the visual space. This geometry which is the measure (metric) of visual sensations is non-Euclidean: it is the hyperbolic geometry of Lobachevski.

We are well aware that our visual sensations give us certain conceptions of the kind of objects viewed and their spatial relationships. Recent investigations, especially by Professor Ames, indicate that the visual stimuli, per se, have no significance but we *associate* them by experience and by intuition with certain significances which influence greatly our action (behavior) and our thinking. It is not obvious that there is any quantitative relationship between these visual (psychological) qualities and any particular geometry. Yet, our sensations provide us with information not only of degree, but also of contrasts. It can be shown that this means that some sort of rule of measurement is implicit in our manifold of space sensation. An example given by Luneburg is that our sensation of pitch allows us not only to state that a certain note is higher or lower than another, but also permits us to detect differences of interval, or contrast, between pairs of notes. We can compare and distinguish between, for instance, three pitch sensations and estimate whether the interval between one pair is greater or less than the interval between the other pair. Likewise, for visual sensations, we conclude that *contrasts* of sensations provide us with the estimation of height or size of objects and of differences of size between various objects. Also, we have the conviction that objects can be moved about in space without influencing their "real" (known) size. The consideration of these judgments and convictions implies the existence of a metric which is essentially and uniquely determined by the manifold of our sensations and that there must be some geometric manifold to which the manifold of sensations can be coordinated. Without going into the mathematical details, suffice it to say that Luneburg apparently has succeeded in showing mathematically that such a coordination is possible.

A further consideration of what Luneburg's "Mathematical Analysis of Binocular Vision" may mean to optometry is that it may

account for some of the various views and teachings of the two schools of thought which may be termed "the classical physicist school" and the more recent "functional school." In binocular vision there is the physical or objective concept of space perception which determines by physical measurements the characteristics and location of objects. These rules of measurement are standard and it does not matter who does the measuring. On the other hand, there is the functional consideration of visual space which is purely subjective. It is a sense by, or of, the individual and may vary with different individuals. Therefore, it is "subjective space." It is important—yet, often neglected in recent optometric literature—to distinguish between "objective" and "subjective" space. With respect to the subjective estimation of visual space, the nature of the stimuli does not alone have significance since the mind of the observer adds such psychological factors as experience, training, expectance, etc., and these influence greatly our visual perception.

In terms of ordinary Euclidean geometry, our visual (subjective) space usually differs greatly from physical (objective) space. However, there may be another form of geometry which explains the visual perception of space. This other form of geometry, non-Euclidean hyperbolic geometry, has been developed by Luneburg. It may prove to be of practical importance by providing the possibility of measuring our patients' space sense. It may help to answer such interesting questions as: Is the space sense of myopes different from that of hyperopes? Is there any correlation between visual skills, manual skills, and visual space sense? Is the space sense measurably influenced by orthoptics or visual training?

These questions cannot be answered immediately by Luneburg's paper. There is yet much to be done. Certain personal constants which Luneburg used in his formulae have to be determined on a large number of subjects. In this task optometrists and others interested in visual science may well cooperate.

Although it is far from easy reading and quite a bit heavier than the usual mental pabulum which nourishes most optometrists, it would be well if some few serious men would study Luneburg's work and open for optometry what may be a new concept of binocular vision synthesizing some of the conflicting thoughts current in our profession. Luneburg's work may prove to be the most important theoretical contribution since the time of Helmholtz.

ROBERT E. BANNON.**

**Your reviewer is indebted to Dr. Paul Boeder for his clarification of several points in Dr. Luneburg's paper and it is hoped that Dr. Boeder will favor us with a further discussion of this important treatise.

ABSTRACTS

A department in which will appear abstracts of the literature of optometry, ophthalmology and applied optics. These will be classified according to the following list although contributions to all sections will not necessarily appear in each issue.

1. Ocular Refraction.
2. Physiological Optics and Color Vision.
3. Ocular Muscles.
4. Orthoptics and Reading.
5. Anatomy, Histology and Embryology.
6. Ocular and General Pathology.
7. Ophthalmic Lenses and Material.
8. Instruments.
9. Hygiene and Illumination.
10. Applied and Physical Optics.
11. Education, Sociology and Economics.
12. Miscellaneous.

1. Ocular Refraction

AIDING THE NEAR-SIGHTED. H. G. Bass. The Canadian Journal of Optometry. 1946. December. 486-489.

The author presents a treatment-to-treatment graph and history of a patient's visual acuity during a period in which orthoptics were employed to reduce the [pseudo] myopia found to be present. The chart shows a before and after visual acuity finding for each treatment period and indicates, in this case, that during the period treatments were given, the patient's uncorrected visual acuity improved from around 20/100 O.U. to nearly 20/25 O.U. The original correction used by the patient was O.D.—2.25 D. sph. O.S.—1.75 D. sph. The treatments covered a four-month period and re-examinations were made over the following nine months with but little change in the patient's prescription. The patient, a woman, age 18, is now wearing O.D. —2.25 D. sph. O.S.—1.50 D. sph. Add O.U. + 1.50 D. sph.

C. C. K.

CORNEAL VARIANCES IN DYNAMIC AND STATIC OPHTHALMOMETRY. H. C. Morgan and A. M. Lombart. Alumni Bulletin of the Pennsylvania State College of Optometry. 1947. 1.1.9-11, and 1.2.10-12.

The authors investigate corneal curves with both distance and near fixation, using a C I ophthalmometer with special fixation targets. A comparison of the readings with distance and near fixations indicates no corneal curvature change of any importance in the reading between near and distance nor any change in the axis reading.

C. C. K.

DYNAMIC SKIAMETRY. Glenn A. Fry. The O-Eye-O. (School of Optometry, The Ohio State University). 1947. 13. 1. 5.

Fry describes the skiascopic test for astigmatism and anisometropia

at the near point as used by the clinic at the School of Optometry as follows: "Astigmatism and anisometropia at the near point can be investigated by means of the skiascope and a target placed at 40 cm. from the spectacle plane. The target should consist of a large black card with a white ring surrounding a ¾ inch hole at the center. Black letters should be printed on the ring. The use of the black cardboard prevents the lenses from forming troublesome images of the examiner's face. The target is mounted on the reading rod and the P.D. of the phoropter is adjusted for near point testing. The lens combinations used to start with represent the distance correction.

"The test is begun by directing the attention of the patient to the letters on the card, and each eye is scoped in turn with the instrument held 10 cm. behind the plane of the target, the scoping being done through the hole in the center of the target. If astigmatism is indicated by a difference in motion of the reflex in the various meridians of either eye, the axis and power of the minus cylinder of the subjective correction should be modified until the reflex is uniform in all meridans. If at this state the reflex is found to be 'with' in either eye plus spheres are added till the reflex becomes neutral. Testing one eye at a time, the skiascope is now moved away until the reflex becomes against and then brought forward until the transition between against and neutral is found. This point should be the same distance behind the target for each eye. In the event that a difference is found, plus spheres should be added in steps of .25 D. to the eye whose neutral zone is farther away from the target, until the neutral zones are equidistant from the eyes.

"If at the beginning an against motion is found when the skiascope is held 10 cm. behind the plane of target, the scope can be moved forward to find the transition between neutral and against. If necessary, minus lenses can be added. The fundamental goal aimed at is to get the neutral zones equidistant from the eyes."

The paper also discusses the general acceptance of dynamic skiametry as well as some of the misconceptions regarding this phase of refractive work.

T. O. B.

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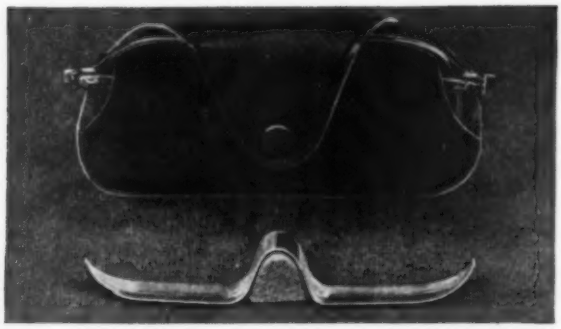

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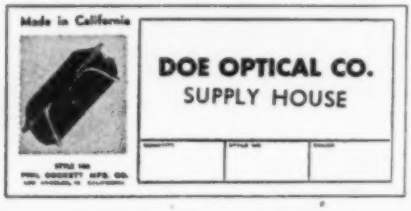

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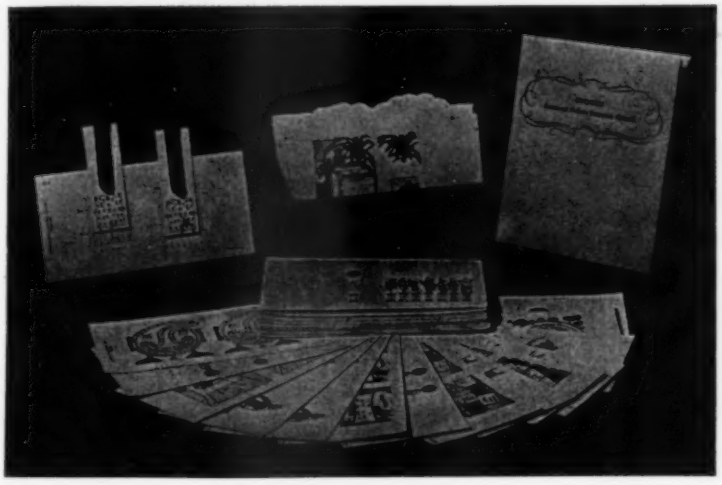

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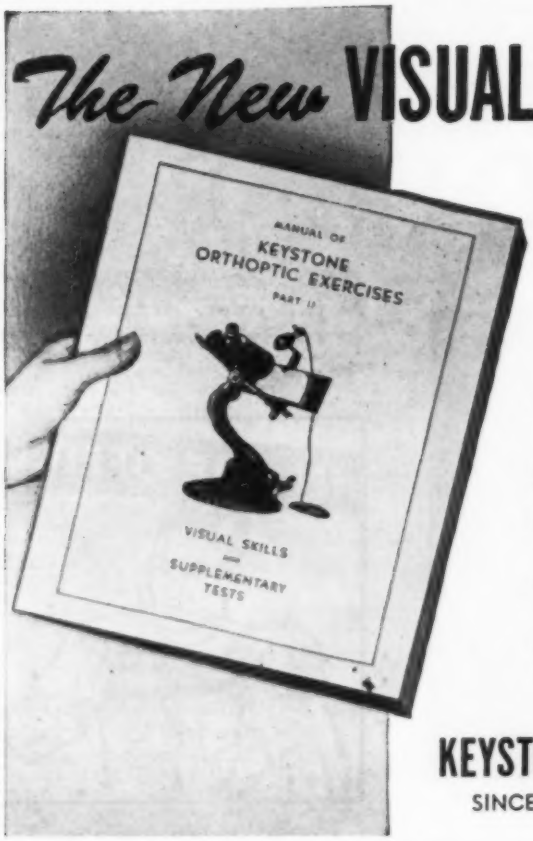

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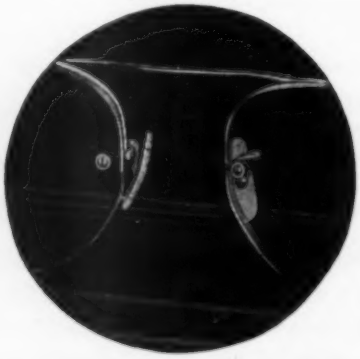

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